# ELECTRONICS Australia

February, 1969

Incorporating RADIO, TELEVISION & HOBBIES Vol. 30 No. 11

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30c

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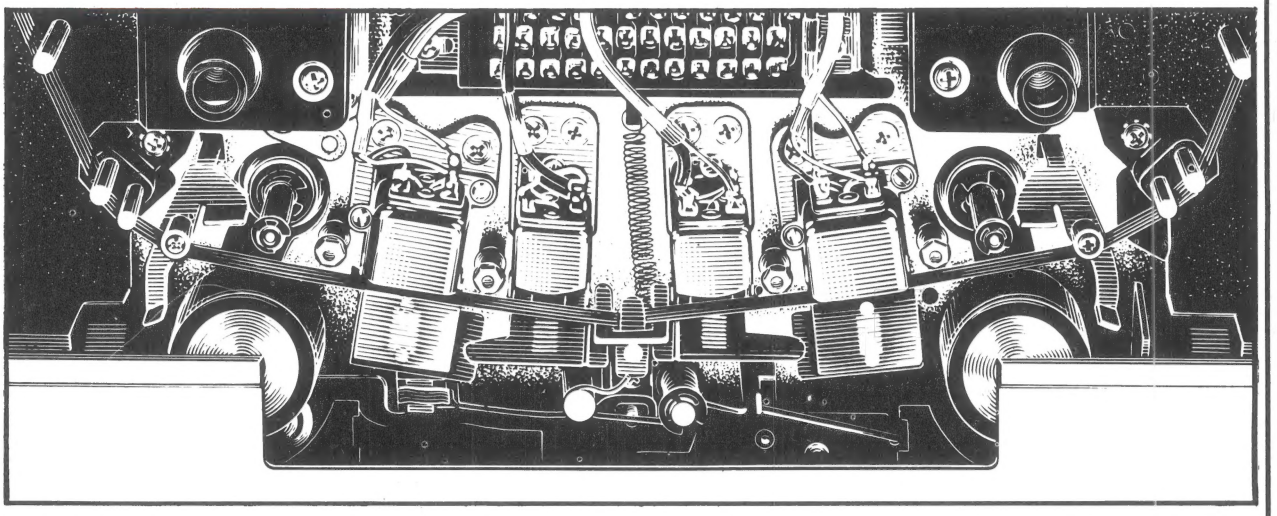

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# ELECTRONICS Australia

Incorporating "RADIO, TELEVISION and HOBBIES"

**ABC certified circulation in excess of 47,000.**

**Volume 30, No. 11**




## Homes raided . . .

A couple of days before this issue went to press, newspapers carried the story of a raid on a number of homes in the Sydney area, where the residents were suspected of illegally using two-way radio transmitting and receiving equipment. By monitoring the frequencies involved, and by the use of direction finding equipment, officers of the P.M.G. Radio Branch had previously pinpointed the sources of the alleged illegal transmissions. In company with C.I.B. detectives, they raided 13 homes and seized a substantial quantity of radio transmitting equipment.

The raid came hard on the heels of complaints, lodged with the P.M.G. Radio Branch, by legitimate users of 27MHz equipment — including people who had been involved in the recent bushfire emergency to the south and west of Sydney. They complained that short-haul communications in the fire area, using supplementary hand-held transceivers, had been seriously interfered with by an illegal network of radio hobbyists; furthermore, that requests to the operators to clear the channel for essential communications had brought only a flat refusal, plus an array of insults.

It is interesting to recall that, in the November issue, we mentioned a letter from a New Zealand reader, who had requested us to lend support to the so-called C-B operators, with a view to enhanced Club activities and Trans-Tasman DX. We replied with a firm "no" because:

- Such activities are at complete variance with the original intention of the 27MHz facility;
- They are illegal in both countries;
- They can too easily lead to irresponsibility, larrickinism and worse.

It will be for the Courts to decide the guilt or innocence of those caught in the recent raids. However, as the regulations stand, they could face charges involving up to 5 years imprisonment, and/or a fine of up to $1000, plus confiscation of the equipment involved.

Whatever the outcome, the P.M.G. Radio Branch should continue to keep a close watch on 27MHz, not with a view to harassing legitimate licencees, who would appear to offend rarely, but on those who either ignore or defy the administrating authority.

Enthusiasts and licensed amateur operators should also examine their loyalties in this kind of situation. No one likes to be cast in the role of a "dobber" but it doesn't do either group any good in the eyes of the public, when the newspapers headline the anti-social activities of radio "hobbyists."

*W. N. Williams*

## February, 1969



*COVER PICTURE: After being melted down in a high-frequency furnace at about 1800 degrees C., Alnico alloy is poured into oil-sand moulds that closely approximate the desired shape of the finished magnet. Alnico magnets are "powerful" and not easily degraded by vibration, heat or stray magnetic fields.*

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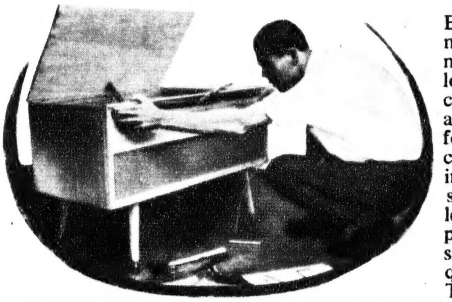
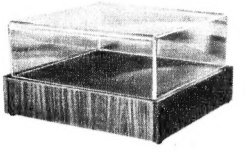
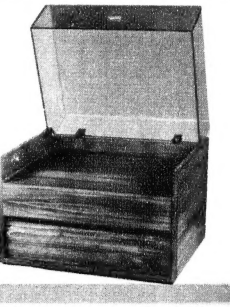


Each kit is complete with all necessary timber parts, plus nails, screws, full, easy to follow instructions. Speaker enclosure kits are complete with acoustic Inner-bond lining felt, and acoustic grille cloth. Equipment cabinet kits include hinges, knobs, catches, sliding stays, castors, slides, leg sets, etc. All timber parts precision cut, fit together smoothly . . . panels are best quality veneered in selected Teak or Queensland Maple. Instrol cabinet designs will cater for virtually any make of speaker, player, amplifier, and tapedeck. If required, all designs are available ready built and polished, but it's highly economical and much more fun to make your own.

**PLAYER STANDS**

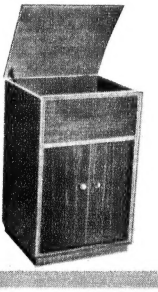
The Instrol range includes a wide variety of player stands and combination amplifier-player cabinets. High quality perspex covers (clear and tinted) are also available, some hinged, others separate.

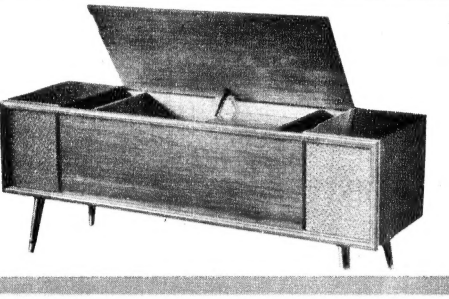




**EQUIPMENT CABINETS**

There are more than sixteen Instrol equipment cabinet designs, all available built and polished or as kits of parts to assemble yourself. They range from massive floor units to compact table models, and include cabinets for record storage and wall shelf units.





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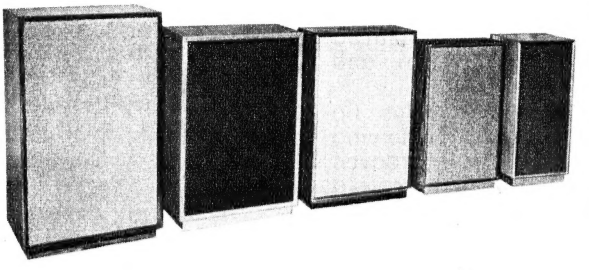
Name your speaker and Introl can supply an enclosure to suit. If it's not in the standard range we can quickly produce enclosures to suit speaker manufacturers' specifications. Enclosures only or complete speaker systems are all available built and polished or as kits.



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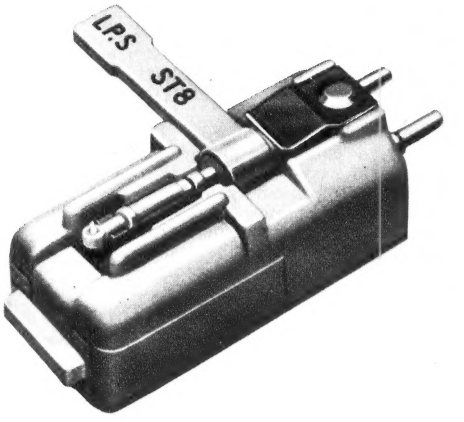


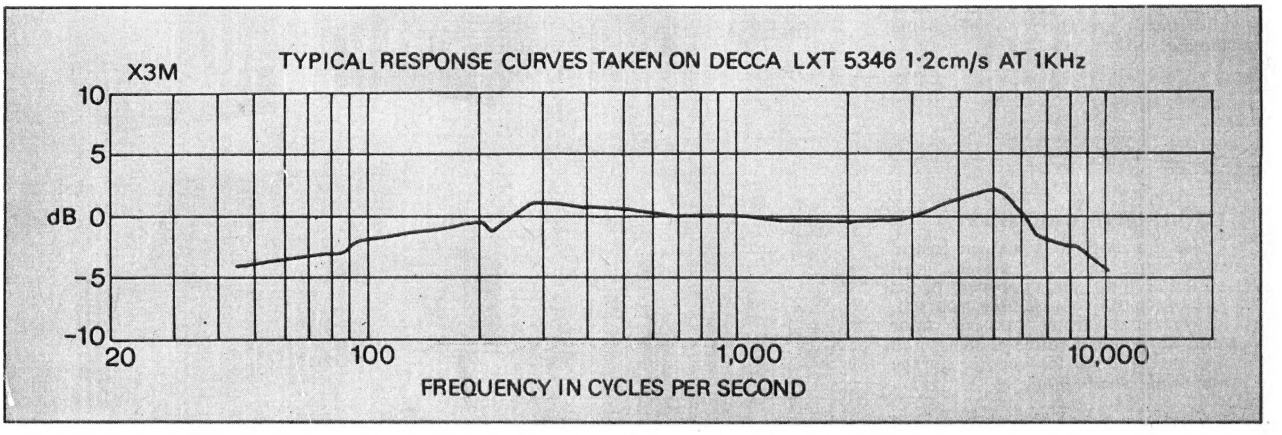


## Why compatible cartridges?

An increasing number of record companies are now making stereo LP records only.

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| Dynamic Compliance: | |
| Horizontal | 3.0 x $10^{-6}$ cm/dyne (±20%) |
| Vertical | 1.0 x $10^{-6}$ cm/dyne (±20%) |
| Equivalent Capacity: | 800 pF |
| Nominal Recommended Loading: | 2 M. ohm 100 pF |
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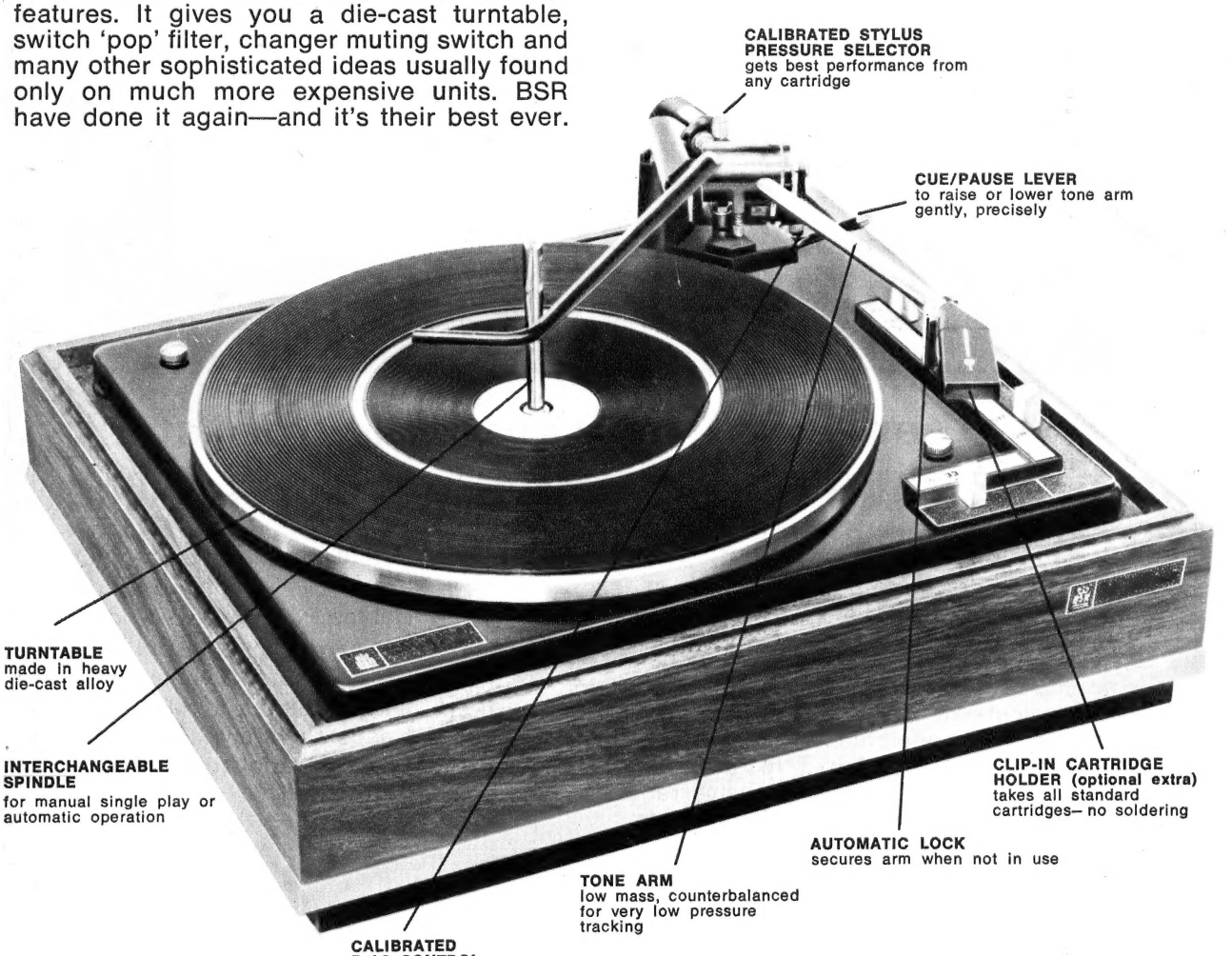


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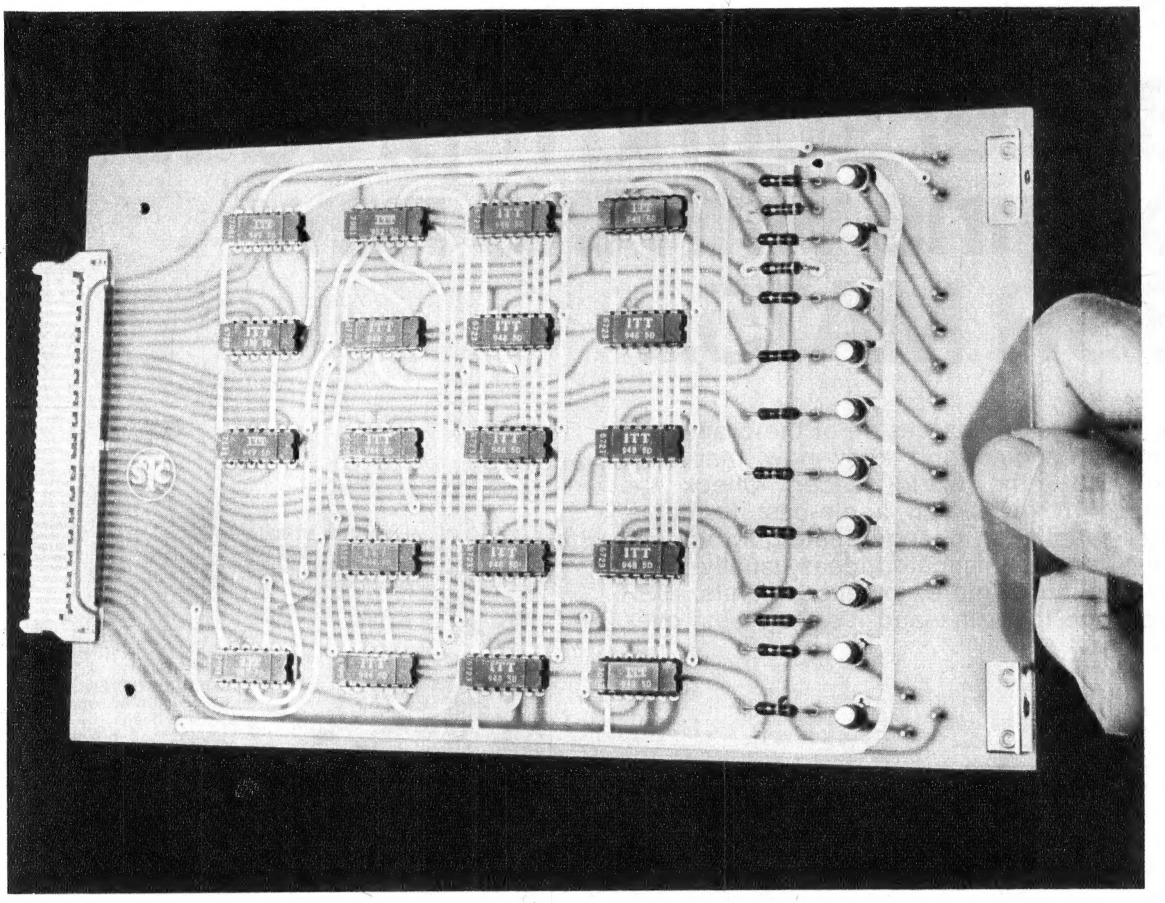

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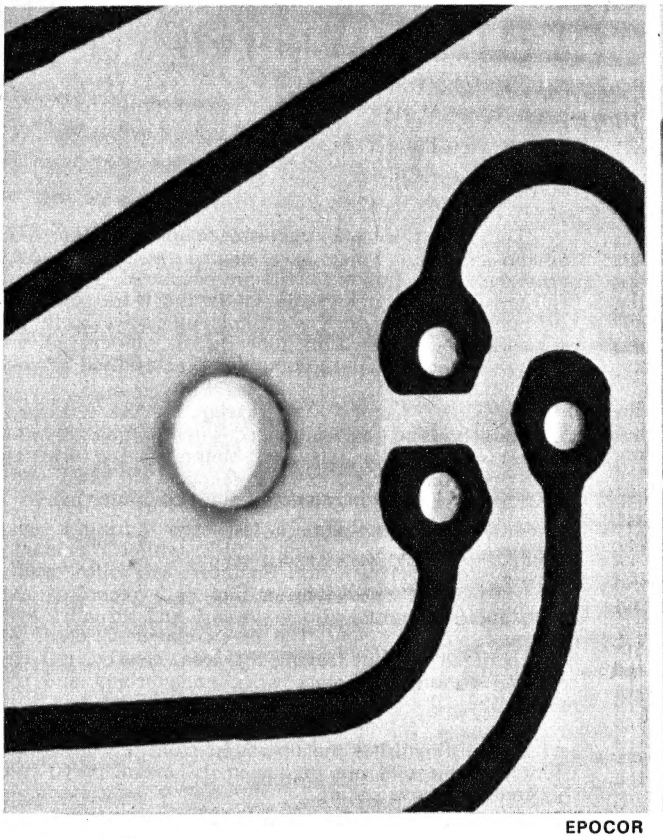

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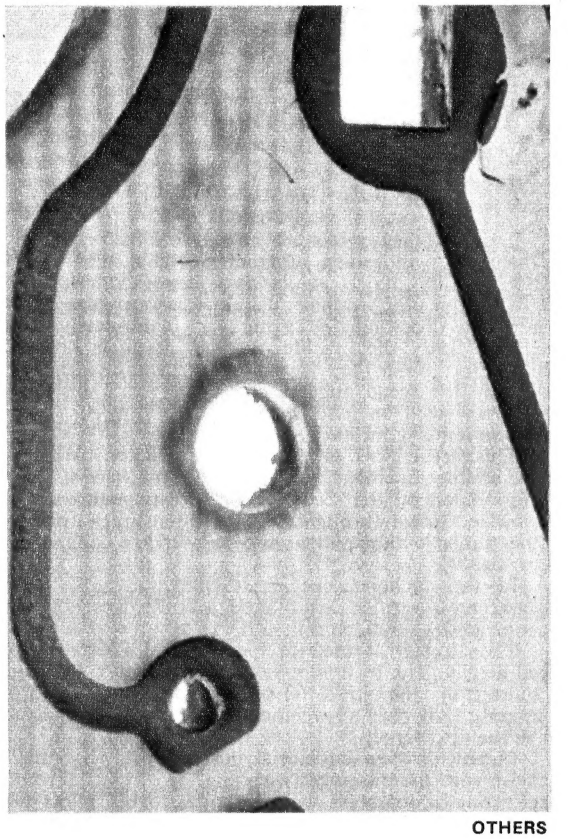

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# SIMULATION — training for real

Two military pilots sit at the cockpit controls, and through the windscreen in front of them they see, 200ft below, a hilly jungle, while they hurtle at 500 mph towards a high cliff straight ahead. Anxiously they scan the area ahead, looking for a target. Completely isolated, they hear only the crackle of static in their headphones, while before them they see only the rushing earth and sky. To them, the scene appears completely real, but it is only a film projected on a screen in front of the cockpit mock-up, simulating a military flying mission.

This scene was enacted at the Renton, Washington, plant of the Boeing Company. As the scene raced on, viewers stood on the second floor of a two-storey building, and looked down through forward tilted green tinted glass at the filmed action and at the two-section cockpit on the floor below.

In the cockpits, special instruments, some of them experimental, verified the plane's attitude, speed and exact location in the simulated mission.

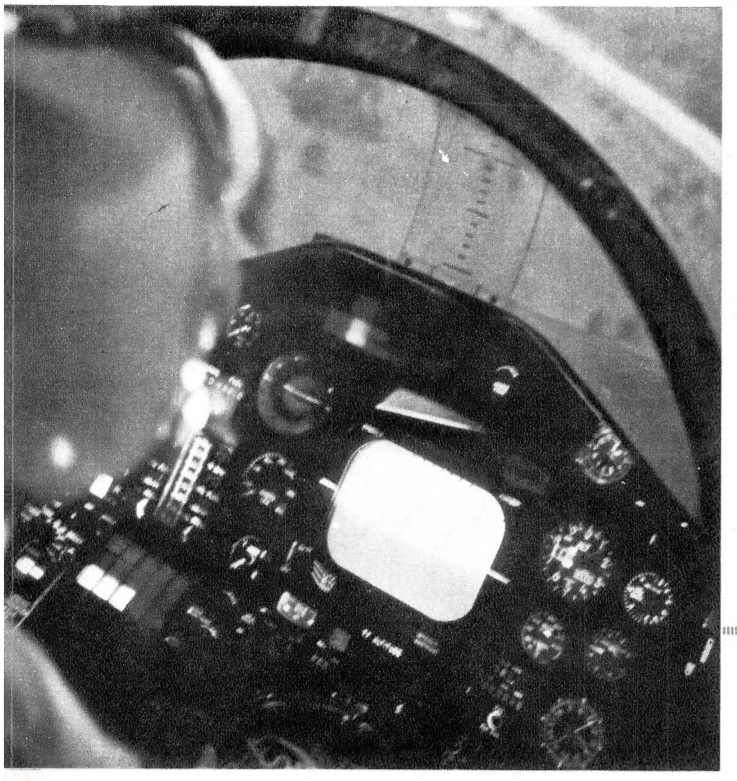
The aircraft seemed to bank and dip as the horizon tilted dizzily. The lead pilot saw his first target. He triggered a button on the stick. Then he levelled off and swept seemingly only feet above the sharp bluff, over a river and on to the next target.

Meanwhile test engineers and support personnel were upstairs with the observers watching the "flight" through the large, soundproof glass wall, listening to the pilots talking, observing data recording devices. They talked to each other about performance, passed on instructions, and in, general, made noises, but none of this intruded on the pilots.

"Electronics Australia" wishes to acknowledge the following sources used in the preparation of this article:

Simulation — Preparing for the Game of Life, by Tom Schachtman (RCA's "Electronic Age," Spring, 1968).

Screen Test for Tomorrow's Plane and Tomorrow's Pilot, by Tom Cole ("Boeing Magazine," May, 1968).



*The cockpit of the Boeing company's flight mission simulator is equipped with all the normal instruments of a combat aircraft, including a moving map display.*

Thus are illustrated the two features of this aircraft mission simulator which have elicited the most favourable comments from military aviation personnel. First, it is a "full-mission simulator," able to tie the world outside the cockpit to that inside the cockpit precisely. Each frame of the 70mm colour film showing on the curved screen in front of the cockpit is computer synchronised to cockpit instruments.

The other feature is the design of the test area. It includes a briefing room equipped with training aids; offices for test engineers; an elevated, sound-proofed observation booth with readout equipment; the cockpit itself, and the adjacent Boeing hybrid (analog-digital) computer bank.

The ability to isolate a test crew during a mission permits observers to monitor a flight without "contaminating" the crew's performance. Engineers can follow each test by closed-circuit television, on-line data recording equipment, audio communications systems and visually through the sound-proof window. The crews can be briefed, tested and debriefed without leaving the area. Nearby, test engineers can go on with other work undisturbing and undisturbed.

Having a full-mission simulator in this self-sufficient test area distinguishes the operation from any other in the country. While it is not unique in its several parts, it is in this comprehensive setting.

This idea for this arrangement grew out of studies Boeing conducted for the Navy and for Joint Task Force 2 (JTF2). This is a tri-service organisation formed to investigate all phases of low-altitude military aircraft missions. During more than 600 flights over areas of Arkansas and Oklahoma, JTF2 tested the ability of pilots to find targets. Boeing, under contract, shot motion picture films of the terrain and accumulated radar and infrared data, television recordings and other information on the same flights. The films and electronic data are used now in re-creating these flights on the simulator. In effect, simulator pilots are re-flying the Arkansas and Oklahoma missions but with control of such conditions as altitude, light and wind drift.

The new simulator, which has been in use since November, 1967, is not part of any one program. It has been used in a number of studies, and in research for JFT2 in some follow-on work to their live "target acquisition" study. Since July, 1968, JFT2 crews have been using the simulator to find out how such factors as cockpit layout, instruments, speed, altitude and weather affect the ability of the pilot to find a target he knows about but has never seen.

U.S. Navy crews, under a different contract, ended a data-collection series of simulator missions last March. They used the same film and electronic data but their purpose was different. They sought to determine whether a two-man or one-man crew would be needed to handle a variety of missions in an advanced, high-performance jet. Such missions might include hitting ground targets, fighting enemy aircraft, reconnaissance, or combinations and variations of these. After the two-man crew data was acquired, all pertinent instruments were moved to the front cockpit panel and the same mission re-flown with one man performing all the tasks. The missions were flown several times, under both visual flight rules and instrument flight rules. The results are now under study and could very well influence both design details and crew complement sizes of some future aircraft.

Such studies demonstrate both the versatility of the simulator and the carefully staged "reality" of the test

# life situations

From its origins in military war gaming, the practice of simulation has now expanded to become a training aid for many activities where a faulty decision could lead to disastrous consequences.


*Illustration by courtesy of RCA (from "Electronic Age.")*

situation. This "reality" is enhanced by the motion picture projection equipment which creates the scene, the setting, the landscape and horizon for each mission flown. The movie screen, viewed from 15 feet away by the pilot, is a segment of a sphere, 160 degrees (in this case nearly 40 feet) wide and 60 degrees vertical. The screen is tilted at the top 15 degrees away from the cockpit, and the projector, likewise tilted, is mounted above and behind the crew. The simulator pilot's field of vision is virtually filled by the motion picture. The 70-mm projection lens, the same one used to photograph the film, is an outgrowth of a Boeing-designed lens used in the 1962 Seattle World's Fair Spacearium. Built by Fairchild Camera and Instrument Company, it projects an image covering the 160-degree screen. The film was taken by a camera mounted in the tail of a converted B-52 bomber and must be projected in reverse to give the illusion of forward motion.

Enough film was taken and enough data gathered so that the simulator can show a wide variety of different missions programs. Thus far, five missions under instrument flight rules and twenty-seven under visual flight rules have been developed for test purposes. In addition to the film, the missons are simulated on sensor displays in the cockpit, including infrared, forward-looking and side-looking radar, television, a moving map display and navigation subsystems.

"It's the closest thing to actual flying yet devised," according to Russell Light, director of Boeing's military airplane product development group. "We can systematically investigate a wide range of realistic flight conditions such as variations in wind and temperature. We can vary any of the conditions, while holding the others constant, to see how mission performance is affected. Soon we may be able to predict pilot performance under specific mission conditions."

The simulator just described is one of a number currently in use in many parts of the world for pilot training. Some are used for training civilian pilots, such as that used by Qantas at Mascot Airport, Sydney, for training pilots in jet aircraft procedures. Although the military and civil aviation use of simulators makes up the greater part of their application, their use is spreading into other fields.

Electronic simulation is now a rapidly growing science that encompasses activities that take place in outer space or the inside of the body, with waystops in the fields of education, business, medicine and engineering. The reason for the rapid rise of simulation is simple: the real world — where astronauts can crash into the moon, or businessmen can drop several million dollars on a wrong decision — is an exciting, everchanging, dangerous, and expensive place. Adequate preparation for problems that arise in the real world, by means of simulation, can serve to make people better players in the game of life.

The modern practice of simulation has its roots in military war gaming. A relevant example is a game developed during the eighteenth century by a Prussian military writer named Georg Vinturinus. Different types of battle terrain were represented by 3,600 squares, which could be arranged into a playing board. A 60-page rule manual was given the the players. Factors for logistics and supplies were carefully included in the game to make it realistic. A later version, in 1840, qualified and codified the game more, giving political information and intelligence reports to the participants and introducing "chance" factors into it. The primary purpose was to educate young officers in the arts and sciences of war and to give them experience in decision-making. War gaming continued to develop as a training device in the twentieth century, reaching the status of a unique art during World War II, when invasions such as Midway and Normandy were played out on huge boards at Allied command headquarters — before being executed.

During the war, gaming became the province of men concerned with operations research — a technique used to break down events or operations into their component parts and then rebuild them with a surer knowledge of the components. This led to simulations of increasingly complex character. During the war, another parallel development came into its own: the Link Trainer. This early simulator allowed pilots to experience the feeling of flying a plane without leaving the ground — training them (as the generals and admirals were trained by war

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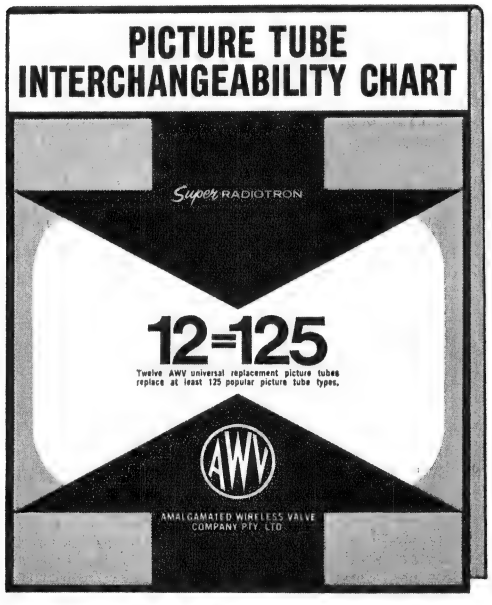


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games in a more grandiose way) for tasks they would have to accomplish in the future.

Improvement in simulators and simulation had to wait, however, for the development of the computer. Capable of juggling great, unwieldy masses of numbers and numerical probabilities, of examining the possible effects of many alternative programs of action, and of translating simple decisions (such as to move a plane up or down) into the reactions of component systems, the computer revolutionized the simulation field. At the Rand Corporation, mathematicians, physicists, sociologists, and other scientists calculated the possible horrors of a future atomic war in great detail. They simulated the destructive effects of a bomb exploding on a city, estimated the probability of our attacking force wiping out an enemy from the air, and mulled mathematically the sociological after effects of a nuclear holocaust. The results of these simulations were used to make recommendations that led directly to the development of defence systems like NORAD, SAC, and the DEW line.

Although most simulations educate by giving experience in that vague capacity we call the ability to make decisions, the uses of simulation in education are more specific. At a Yorktown Heights, N.Y., school, elementary-school children make believe they are the kings of the ancient kingdom of Sumer. The simulation lets the king — in the person of the individual child — play against a computer which takes the part of the chief steward and top adviser to Sumer. Half a dozen children play the same king simultaneously, since the computer is fast and facile enough to do all the computations necessary for several reigns at once. The computer gives the ramifications of decisions that the "king" chooses — such as not rationing the grain in a year of famine — and offers the young monarchs advice on choices they must make among alternative strategies for administering their kingdoms well. Thus, the computer becomes a fund of information, a suggester of alternatives, a tally machine for decisions, a consequences reporter — and an excellent and challenging programmed learning device. After the students have finished a simulation, they understand a very great deal about what Sumer and its kings must have been like.

*The Boeing flight mission simulator, showing the projector mounted behind the twin cockpits. The projected image is seen by the pilots on a curved panel for added realism.*

*The scenes used in the Boeing flight mission simulator were shot on 70mm film, and projected through the same lens used in the camera. Here, a technician is seen examining a portion of film about to be projected.*

Simulation for decision-making training and for other educational purposes is widespread. But simulation can also be used in ways that presage a new era in original research. With the aid of a computer, scientists can now simulte many areas of life not previously accessible to detailed work. One obvious boon is to medical research. Many things about the human body are still unknown — for example, what happens to the body when the heart is weakened. John McLeod, scientist and editor of the magazine. Simulation, has built a computer model of the bloodstream, a simulation in which oxygen, carbon dioxide, nutrients, wastes, heat, chemicals, and radioactive tracer elements are quantified and then manipulated as they might be in a pathological condition such as that of a weak heart. Rand hydro-dynamicists are studying blood flow in the minute capillaries of the eye, simulating by computer methods a small body system in hopes of finding out what happens to that system — say, in the eyes of a man watching a radar scope for approaching enemy planes — under stress. Researchers in many drug companies make a computer model of a part of the human body. Then, they make numerical equivalents of the chemical actions a new drug might have on a body system — before they compound the new drug in the laboratory.

Companies in other fields can try out designs for aircraft structures or revised marketing and pricing practices with simulation. A numerical model of the system to be tested is made up and put into the computer's memory. Then individual factors within the numerical model are manipulated and the effects on the total model are calculated. Whether your concern is a hypersonic aircraft of a special design collapsing at 60,000 feet or a new pricing policy for a breakfast cereal that will lower or raise your share of the market for that product, the results of the simulation are valuable. Simulation allows for mistakes to be made before they become too costly. In the words of a Rand researcher, they let the person using the simulation learn from bitter experience without suffering the consequences of those experiences.

But military matters are not always so spectacular as trying to outguess a future nuclear war. Logistics, supply —factors that concerned even Vinturinus in the eighteenth

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century — have multiplied in importance, and in headaches, as well.

Managing logistics and supplies for an army whose bases are spread around the world and whose expenses run to many million dollars a year is a mammoth job. Logistics managers for the U.S. Army are now being trained for their complex tasks by the use of computer simulation methods. At Fort Lee, Va., where the U.S. Army Logistics Management Centre, has its headquarters, an RCA 501 computer is used solely for training army and civilian personnel from all over the world in logistics management. Approximately 4,000 students annually do simulations on the computer.

Computer Assisted Logistics Simulation, or CALOGSIM is one of seven exercises developed and used at the Centre as capstones of regular courses in management required for logistics people throughout the Army. In CALOGSIM, the students play the roles of commodity managers at an Army National Inventory Control Point (NICP). All the data used in the simulation are taken from real NICP data, and the students perform functions done by real life NICP managers. They control 50 principal items — such as tanks or radio sets—and 450 secondary items and repair parts ranging from nuts and bolts to helicopter rotor blades. By using the computer to compress time and to calculate the effects of supply decisions, the students compress 48 months' worth of logistics decisions into 48 hours of simulation time. They undertake normal problems of phasing in new items, scheduling repairs, redistributing stock, obtaining funding, and so forth that face real-life, real-time managers. They also are confronted with funding cutbacks, strikes, floods, increased demands caused by limited wars — in other words, all the things that make supply managers go grey at an early age.

The other six simulations, used in other courses, deal with more specific logistics activities such as repair, maintenance, or disposal as specialties in themselves. In these, as well as CALOGSIM, the students are presented with a unique opportunity to make decisions and manage supplies in an environment where the effects of a bad decision is only a student's chagrin — not a million-dollar supply mistake. Both the teachers and the students feel that the objectives of the simulations are achieved: to give the participants "accelerated experience" and make them better managers.

The world of business has adopted simulation, too. People must be trained to make good business decisions. As part of a top-level course in training executives, the American Management Association (A.M.A.) in New York City has developed an elaborate exercise model called Top Management Decision Simulation. Several years of activity by a fictional company are compressed — by computers and careful planning of alternatives by A.M.A. representatives — into a few days. The participants are forced to make decision after agonising decision as executives of the fictional company making a fictional product. The computer calculates the impact of decisions to add to inventory, increase the number of salesmen, make a large bank loan, and so forth. Carefully planned

**(Continued on page 158)**

# NAVIGATION SIMULATORS IN U.K.

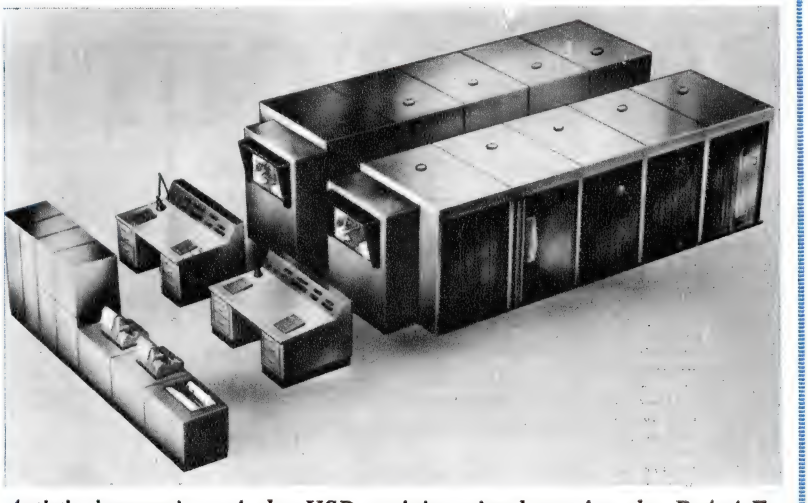
Training simulators developed specially for navigational training, instead of purely pilot training, have been developed in U.K. and are to be supplied to the R.A.A.F.

The equipment has been developed by Elliot English Electric Automation Ltd., 21 Portland Place, London, W.1., and is to be supplied to the Royal Air Force and the Royal Navy, as well as to the Royal Australian Air Force.

The two R.A.F. simulators have 10 and five training cubicles presenting the navigator's position in Dominie jet aircraft; the single Navy simulator will have six positions for pupils and will be adaptable for training navigators for Buccaneer, Phantom, Sea Prince aircraft and helicopters. The R.A.A.F. simulator will be representative of the HS748 navigational trainer and will have 12 student cabinets.

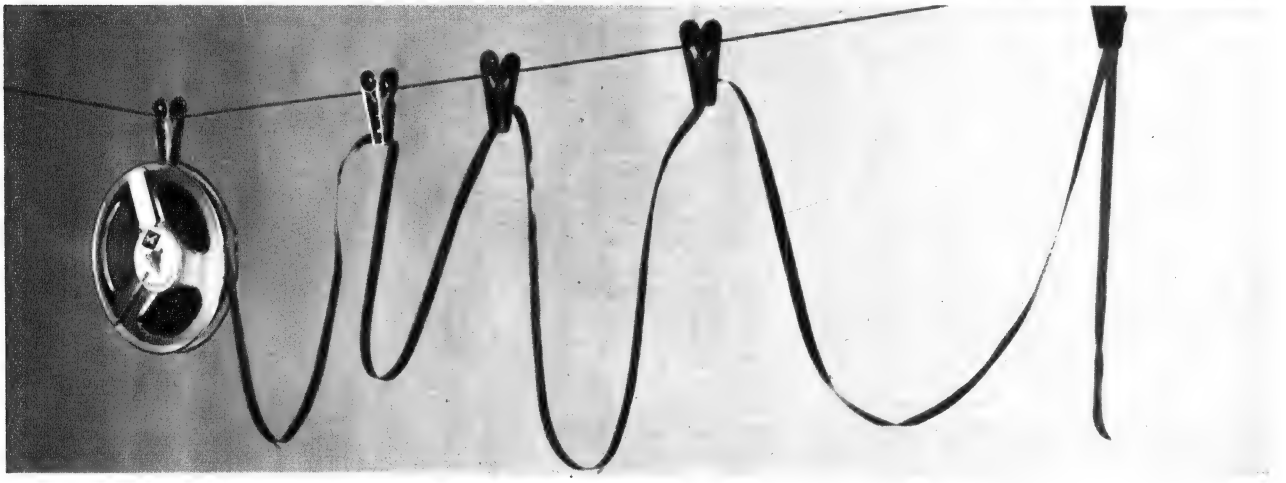
The simulators are digitally controlled: two HSD DCC-2 computers in the R.A.A.F. model and E. E./ Elliott 4130 computers for the R.A.F. and R.N. versions. Computer output is used to drive the display instruments digitally by stepper motors, which is said to give better accuracy and stability without elaborate environmental and stabilising devices than where analogue systems are used. The electronic circuitry is modular in construction, using 8in x 6in plug-in printed-circuit boards incorporating the latest integrated techniques. Extensive use has been made of transistor-transistor logic.

*Each pupil's cabinet in the Stimulator duplicates (with sound effects) a navigational station in the R.A.A.F.'s HS 748 trainers.*



*Artist's impression of the HSD training simulator for the R.A.A.F. Bottom left is the computing and recording equipment.*

The instructor's control desk has a read-out display on which he can obtain information from any one of the students' cubicles by pressing a button. He is also able to inject failures or changes of conditions — for example, wind speed or direction — from those in the programmed exercise. There is also a track indicator to show how the "journey" is progressing and a post-exercise plotter which prints a plot of the actual track that each student has evolved.

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# Fingerprints Matched by Computer

The National Bureau of Standards in the U.S.A. has completed the first stage in the development of a computer system for encoding fingerprint identification.

The work on the computer fingerprint system is being undertaken for the Federal Bureau of Investigation, which currently has 60 million sets of fingerprint impressions on file. Joseph Wegstein, of the N.B.S. Centre for Computer Sciences and Technology, designed the procedure, which uses a computer to produce compact descriptors based on the minutiae (fine details) of fingerprint impressions. When completed, the system will produce a matching "score" for each fingerprint comparison, whether a complete or only partial impression is available. Automating even part of the fingerprint identification process will reduce the manpower required to search for matches and could speed identifications.

The use of fingerprints is impeded by the difficulty of classifying them succinctly; the Henry system, which has been in use for over 60 years, requires impressions of all 10 fingers. In searching for a matching fingerprint, a 100 or so in the same Henry classification must sometimes be inspected. This work is done manually and the results of the search are not available as rapidly as might be the case with computer-stored information.

In planning the computer-aided identification system Mr Wegstein took advantage of the uniqueness of fingerprints and used a single-fingerprint identification, which could later be expanded to a full 10-print system if desired, in order to minimise computer memory requirements and speed the search procedure. In use, the system will identify the impressions that give the best match; they will then be submitted to an expert for matching. If ever a device for automatically reading minutiae from fingerprint cards is perfected, the system will offer great economies and faster service.

Fingerprints currently are identified, in the Henry system, by the presence of pattern characteristics (arches, loops, and whorls) and by counts of the ridges between certain features. This method is tedious and not readily adapted to a computer. On the other hand, two fingerprint impressions can be demonstrated to come from the same individual by an altogether different method.

Mr Wegstein chose to characterise fingerprints by comparing only certain groups of minutiae from among the ridge endings, bifurcations (forks), incipient ridges, islands, and enclosures that make a fingerprint unique. Sufficient correspondences to prove that two impressions originate from the same finger can be obtained in this way even from partial prints that could not be classified by the Henry system.

This technique uses the location and orientation of just two kinds of minutiae; ridge endings and ridge bifurcations. The position and direction of each minutia are marked on a transparent overlay on a 10x enlargement of the fingerprint impression, using as a reference arbitrary X-Y axes. The X and Y co-ordinates and direction are recorded for each minutia. This is a manual stage which eventally may be performed by machine.

The typical fingerprint contains about 80 minutiae, depending partly on how much the finger is "rolled" when the impression is taken. Each minutia is assigned in turn as a focal point, for which the computer seeks out others lying within a distance d of it and having a direction differing from the focal minutia's direction by an angle less than $\alpha$. Trial focal points having at least W other minutiae in its consellation are retained if they do not duplicate others previously found. The parameters W, d, and $\alpha$ can be varied to make the comparison more or less selective; four to 12 constellations per impression can be expected for the values: W = 4, d = 20 mm, and $\alpha = 12°$.

At this point the computer is dealing with the location and orientation of minutiae forming the acceptable constellations. Its next step is to transform the co-ordinates of each minutia in a constellation so that the co-ordinates are independent of the position and angle at which the impression was made.


*Location and direction of ridge endings and bifurcations of a fingerprint (top) are represented by lines on an overlay drawing (below).*

The computer is programmed to compute new X and Y co-ordinates for each minutia in a consellation relative to co-ordinate axes centred in the constellation itself. The Y axis is rotated so that it lies along the mean direction of the minutiae in the constellation.

Next, all accepted constellations are placed in a qualitative form by assigning to each constituent minutia a relative position. As one proceeds in the X direction, the Y value for each minutia in a constellation is replaced by a ranking integer. The resulting string of integers constitutes the main part of the descriptor. Thus, in a four-minutiae constellation, the descriptor 2-0-3-1 would indicate that the second minutia had the smallest value of Y and the third had the largest. Descriptors are further abbreviated by replacing the strings of permuted numbers by individual code numbers.

A system using the fingerprint descriptors will encode, for each print an entry giving, for each constellation, its direction, co-ordinates, and compressed descriptors, as well as an identification number for that impression.

The second phase of the project involves experimentation with various methods of matching fingerprint descriptors. In one promising approach, descriptors for two impressions in the computer file are compared and a total score obtained for their similarity. High scores indicate a similarity and justify visual comparisons. ■

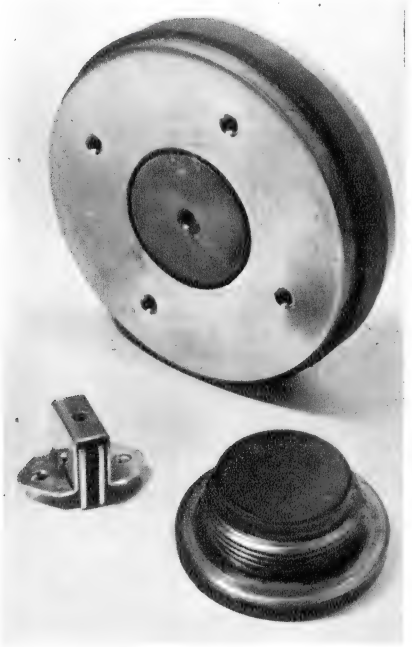
COVER PICTURE

# ALLOY MAGNETS — 30 years

The concentrated research that has gone into the nature of magnetism and magnetic properties of matter during the past thirty years has led to the development of new magnetic materials which, among other things, have revolutionised loudspeaker design. The present availability of compact but powerful magnets has also led to an ever-growing variety of uses for magnetic devices.

For nearly three thousand years the natural magnets, known as lodestones, were a mere curiosity, the playthings of magicians and pseudo-healers. Until the discovery of the north-south alignment of magnetic materials, they had absolutely no practical value, and right up to the nineteenth century the navigational compass was the only practical use found for magnets. Even this application was not realised until the sixteenth century, when its use in exploration vessels led to many epic voyages of discovery.

The work of Michael Faraday in the early nineteenth century established the relationship between magnetism and electricity, and led directly to the work of other researchers which became the foundations upon which the great science of electronics was subsequently constructed. The electromagnet proved to be far superior to the permanent magnet for some applications, by virtue of the powerful fields which could be obtained from relatively compact units. However, the permanent magnet continued to play a major role in some types of equipment where a relatively weak flux field was sufficient, or where the power requirements and heat dissipation of an electromagnet could not be tolerated.



*Three of the now common uses for ferrite magnets. At top is a magnet assembly for a large high-quality loudspeaker. At left is a magnetic door catch. Bottom right is an oil sump plug with magnetic disc for collecting metal particles.*

When radio telephony first became a practical proposition during the first decades of the present century, headphones were used as transducers. These followed the well-established design of telephone receivers, using a permanent magnet to provide the necessary fixed magnetic field, or bias, an electromagnet to convert the incoming signals into a varying magnetic field to operate the diaphragm. With the advent of more powerful output valves, came loudspeakers which, initially, were simply overgrown headphone units arranged to drive a horn or a cone. The balanced armature drive unit was an improvement, and enjoyed a brief popularity. Both basic systems retained the permanent magnet.

However, loudspeakers did not really come into their own until the development of the moving coil or "dynamic" variety, the basis of the present day variety. A prime requirement for this type of speaker is a strong field magnet; something which was beyond the capabilities of the permanent magnets of those days. So, initially and for many years to come, these speakers used an electromagnetic field magnet almost exclusively. Some permanent-magnet loudspeakers were made in the 1930s, but these had massive magnets which tended to make them inconveniently large, and also expensive.

At that stage, the only commonly used magnetic materials were iron, nickel and cobalt. (The rare earths dysprosium and gadolinium were known to have magnetic properties, but these were not used commercially.) The development of Alnico magnets led to the design of practical permanent magnet loudspeakers. This development gave rise to the complete demise of the dynamic loudspeakers, with their inconvenient electromagnetic field coils. Later still, ferrite magnets were developed, and these proved to be even more effective for loudspeaker design.

Researchers in Australia have been well to the forefront throughout this rapid development of the permanent magnet, and in the early 1940s the Rola Company (now a division of Plessey Pacific) pioneered production here of the high energy Alnico alloys. Today local manufacturers supply magnets for an incredibly diversified range of products.

However, before examining in more detail the vast application of the permanent magnet throughout industry, science and the home, a brief account of its history and development makes an interesting story.

It became obvious to the early scientists that the composition of metals bore a direct relationship to their ability to make and retain magnetic properties. At this time no one had as much knowledge of magnetism as is possessed by most High School students today. It is now known that the basic magnetic field is due to the motion of the electrons in the atoms or molecules of the substance, and that these tiny individual magnets can produce a detectable magnetic field when a significant number of them are aligned in the same direction.

These early workers started producing permanent magnets from high carbon steel. Then by trial and error, and along with a growing understanding of the construction of the atom, they changed to steel alloys, which contained not only carbon but also percentages of chromium, tungsten and cobalt.

To develop the optimum properties of steel alloys, it was essential that they were fully hardened, which eventually gave rise to the name "hard magnets" to describe permanent magnets. Advancing technology found the steel magnet very limited in its application. It was relatively unstable and it could tolerate neither vibration nor heating, as these caused loss in performance.

A major breakthrough in the development of the modern magnet alloy occurred in Japan in 1932 when T. Mishima produced the ferrous nickel aluminium alloy. This was regarded as a most important contribution in the field of hard magnetic materials as it led to the modern form of Alnico materials.

It was basically cast, carbon-free iron, alloyed with aluminium, nickel, and cobalt, that has become known now as Alnico 2. Very different from the steels, it was vastly superior in stability and had advantages of increased field strength, resistance to vibration and ability to withstand temperatures of up to 500 deg. C.

The next break came soon after, in 1940, when Alnico 5 was developed. It achieved a very high magnetic quality in one direction only. Until this time all permanent magnet steels and alloys had been magnetically isotropic, that is, their magnetic properties were equal in all directions. The new Alnico 5 alloy was anisotropic which meant its optimum magnetic properties were in a single, predetermined direction—this directional effect being the result of the manufacturing process. Ten years later came the introduction of yet another revolutionary magnet material—a non-metallic oxide, barium ferrite. Its advantages were the relatively low cost of the raw materials, iron oxide and barium carbonate, and

# progress

the composition's outstanding resistance to demagnetisation.

Although other materials have also been found to be excellent permanent magnets, these two — Alnico and barium ferrite—are by far the most commonly used materials. Both products are extremely hard and brittle, but here any real similarity ends, as can be illustrated by a brief outline of the manufacturing processes.

The elements that make up the metallic Alnico magnets are melted in an induction furnace at approximately 1,800 deg. C. This alloy, of aluminium, nickel, cobalt and iron, is then poured into fine oil sand moulds. These moulds approach as exactly as possible the ordered shape of the magnet because of the difficulties of machining this brittle alloy.

The castings are then heat-treated at around 1300°C. A controlled cooling process then follows to form the characteristic crystal structure needed to optimise the permanent magnetic properties. Where anisotropic magnets are required, a strong magnetic field is applied in the preferred direction at a critical stage in the heat treatment cycle.

The ferrite magnets, as they are known, are ceramic in nature and the raw materials are initially synthesised by blending, then reacted chemically with heat. This reaction product is finely ground before being compacted in high pressure dies. The compact is sintered, or baked, at a controlled temperature (usually around 1300°C) to impart the optimum magnetic properties. To provide a preferred direction of alignment to a ferrite magnet, a strong magnetic field is applied in the required direction during the pressing, or compacting, phase of the operation. Because of its crystalline form the ferrite magnet is even harder to work and the only effective method of shaping or sizing is by use of diamond impregnated grinding wheels.

To differentiate between the relative values and uses of the two materials it is necessary to point out that the key properties of magnetic materials form points on the "demagnetisation" curve, or second quadrant of the hysteresis loop for the material. The de-magnetisation curves for those two most commonly used permanent magnets appear in figures 1 and 2.

Perhaps a simpler illustration can be provided by the application of both types of magnets in the manufacture of loudspeakers.

Until recently, the most commonly used loudspeaker magnet assembly was the centre-block type, using a cylindrical Alnico magnet in a soft iron shell. A pole piece and front plate collected the magnetic flux and concentrated it in the small annular gap in which the voice coil works. This assembly can be seen in figure 3.

The characteristics of Alnico required the magnet's length to exceed its diameter for efficient operation, but

(Continued on page 158)

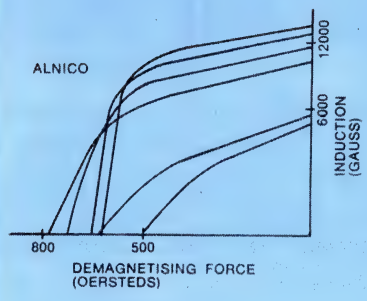



Figure 1

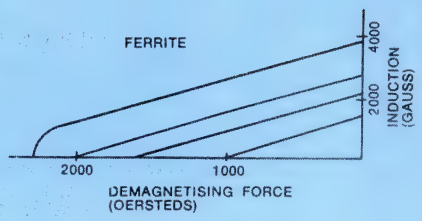



Figure 2

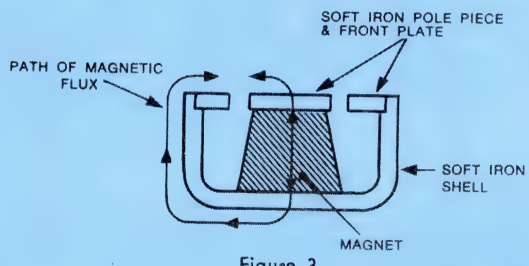



Figure 3

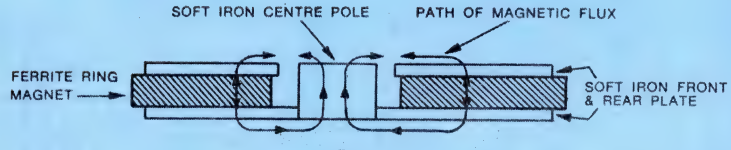



Figure 4

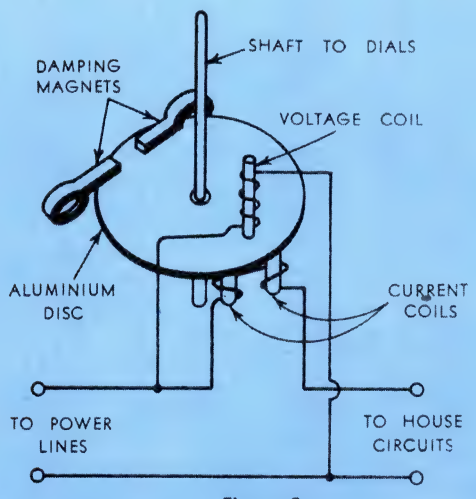



Figure 5

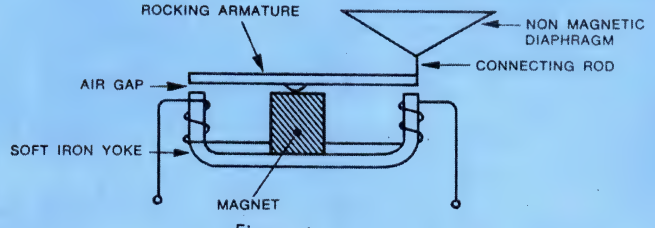



Figure 6

# TRANSLATORS ARE FILLING THE GAPS

Many pockets of population which cannot receive satisfactory television signals from the main stations operating in their districts are now being provided with programs retransmitted from translator stations. Some of the problems involved in establishing these stations, both political and technical, are discussed in this article.

by Brian Carroll

While the industrialised nations have brought television to most of their land areas (Britain now covers 96 per cent, for example) about 85 per cent of the Australian continent will not have television coverage in the foreseeable future. This is not because the television planners have fallen down on the job. The reason is simply that there is nobody there to watch televsion programs, even if they were available. However, just providing programs for the areas where people do live has had its problems.

After 12 years of Australian television, the population within reach of television transmissions is now reaching close to 97 per cent. This has been achieved by the use of translator stations to fill the gaps left after the main stages of television development, planned by the Australian Broadcasting Control Board, had been completed. In the past few years, increasing numbers of translators have been brought on the air to serve pockets of population which previously had not been able to obtain satisfactory reception from the existing service.

This was by no means an unexpected development, for it was already a well-known problem overseas. Two methods had been used elsewhere to overcome this: community television aerial systems, and translators. Several community antenna systems had been authorised, and they were all very well in small areas of concentrated population. But, by and large, translators seemed to be a better idea for Australia.

Since translators are intended to serve a limited service area, their output is low, the smallest having only one watt of output, and the largest one kilowatt. In comparison with this, the capital city stations have an effective radiated power (vision) of 100KW.

Naturally, the first places in Australia to have television stations were the capital cities. To Sydney's TCN 9 goes the honour of being first on the air, with transmissions beginning September 16, 1956. Next was Melbourne's HSV 7, on November 4. By the end of 1956, both cities had three stations each on the air. Brisbane, Adelaide and Perth all received their first television programs in 1959, and Hobart in 1960.

In 1961, television moved into the country areas for the first time. Licences were granted for the establishment of 13 commercial stations for large provincial areas, and in December, 1961, these began coming into service. The remaining stations came on the air at intervals, the last to become operational being ready in September, 1963. Concurrently with the spread of the commercial television service, 13 National stations planned for the same country areas began to operate, and the last of these began transmitting in September, 1964.

A further program for the establishment of 17 more commercial stations and 20 national stations was then begun, to serve smaller country areas. This was completed in August, 1968. However, it had been apparent to those planning the television service that there was an economic limit to the number of television stations which could be established, and that some smaller communities could not hope for a station of their own. This applied particularly to the commercial television service, which had to make a profit from its advertising revenue, based on mass coverage. Even some of the areas for which a commercial service had been planned did not get a commercial station, since no suitable applications for licences were received.

The time was ripe for the introduction of translator stations, the function of which was to receive programs transmitted from a parent station, amplify the received signals and retransmit them on a different frequency. But since the translators were technically television transmitting stations, within the meaning of the Act controlling public broadcasting, there were certain legal difficulties which had to be overcome.

Translator stations could have been established under the existing legislation, for they fitted the definition of a television station. But there were two inhibiting factors. First was the need to go through the rigmarole that usually accompanied the granting of a licence for a commercial television station, including public hearings. Second, there was the limitation on ownership of television stations to two. Once the owner of a commercial station had a translator also, he would not be allowed any more licences. Few would be willing to give up the possibility of another full-scale television operation just for the sake of a translator.

The regulations relating to television broadcasting had therefore to be amended to exempt translators from the provisions intended to apply to main stations. Introducing the proposed changes, the Postmaster-General spoke of "areas which, although not a great distance from existing transmitters, are inadequately served because of the topography of the country."

Actually, television translators had already got off to an unscheduled start. On March 27, 1965. one started operating in Mudgee, New South Wales, picking up the signals of Channel 8, Central Tablelands, and retransmitting them on Channel 5. Two days later, the transmissions ceased, on official directions. Other unauthorised transmissions took place from a translator unit in Crookwell during April, 1965, using the signals of WIN Channel 4, Wollongong.

Before a translator could be installed, each area had to be separately surveyed, to find the best site. First and foremost, there had to be good incoming signals. Sometimes these had to be recorded over a period to test their suitability. In the case of western Tasmania, for instance, a recording station was set up on Mount Read, and signal strengths from Launceston recorded for two weeks. Sometimes the signals were of useful strength, but at other times they were quite unsatisfactory for translator use. At the same time, signals from Hobart, received on Mount Owen, were found to be considerably stronger and steadier. So it was decided that western Tasmanians should get their television from Hobart.

It is also important that a translator site be suitable for transmission into the target area. Test transmissions are sometimes necessary to ensure that reliable reception is possible from the site.

Often it has been found necessary to have the receiving and transmitting aerials some distance apart. The translator at Lithgow provides a good example of that. The best site for a transmitting aerial to serve the city was not the best site for receiving signals from CBN Channel 8, because of a high noise level. A much better site was found half a mile away. The two installations were joined by an underground co-axial cable, with an amplifier in a pit near the receiver.

Translator stations are particularly effective in Tasmania, where the mountainous topography creates many pockets where direct reception is impossible.

Hobart commercial channel TVT operates on Channel 6. Its signals are picked up by the repeater station on Mount Owen, which transmits them on Channel 8 to Queenstown and Zeehan. The Channel 8 signals from Mount Owen also go to another translator on Mount Read, which directs them on Channel 10 into Roseberry and Renison Bell. There are similar arrangements for Channel 2. TVT 6 also has translators at Swansea-Bicheno, Taroona, and the logging town of Maydena, where the timber for the Australian Newsprint Mills Ltd. plant at Boyer,

**(Continued on page 21)**

**AKAI RECORDERS**

All AKAI models are now in stock . . . M9, XV, 4000D, X150D, X360, X300, 1710W and the X1800SD. Ask for your Encel price or a trade-in valuation. Sorry . . . we cannot advertise the low Encel prices!

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This beautifully designed lifting/lowering device fits all types of tone arm. Action is velvet-smooth . . . and the lift is a fitting companion to the high quality precision Grace arms.

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Orders for the new Nikka-Lustre Model ST-510 tone arm can now be filled immediately. Miniature ball races are used throughout, the head shell accepts all standard ½" mounting cartridges, finish is satin chrome and anodised aluminium. An outrigger bias adjustment is fitted and stylus pressure is adjusted with the counter balance weight. The Model ST-510D is fitted with a lifting/lowering device and costs $24.50. The Model ST-510 (without lift), inc. sales tax is priced at .... **$19**

**CP3 TONE ARMS IN STOCK AGAIN**

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**NEW MODEL MICRO MAGNETIC STEREO CARTRIDGE**

Now Micro have released a new series . . . the Models 3100/5 and the 3100/E (with elliptical diamond stylus). Both cartridges have an extended frequency response (20-25,000 Hz.) and performance is outstanding. Write or call for additional information and prices.

**LOW PRICED CERAMIC CARTRIDGE FOR BUDGET CONSCIOUS MUSIC LOVERS!**

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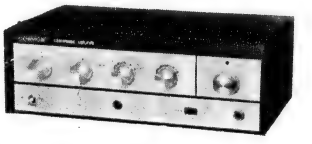

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**FIVE LOW COST, HIGH PERFORMANCE SPEAKER SYSTEMS FROM ENCEL ELECTRONICS!**

Separate speaker systems are essential if you wish to exploit the full potential of your amplifier, tape recorder or radio. Sonics speaker systems are beautifully finished in selected walnut/teak veneers, are styled to blend with period or modern decor and are extremely effective from an audio point of view. The following five models are the most popular.

**MODEL AS-57** Bookshelf type — Measuring 15¾ in. x 5¼ in. x 8½ in., this enclosure is compact and most effective. The speaker unit is an oval wide range loudspeaker. Priced at only .... .... .... .... .... .... **$22.50**

**MODEL AS-60E** Slim Line 2 Speaker System — Although only 18 in. x 12 in. x 5¼ in. the AS-60E houses a bass/mid-range speaker and a high frequency reproducer. Impedance: 8 ohms. .... .... .... **$27.50**

**MODEL AS-61** 5 Speaker Slim Line System — Four bass/mid-range speakers and 2½ in. tweeter unit are housed in this attractive teak/walnut enclosure. Impedance: 8 ohms. 21¾ in. x 17¾ in. x 4¾ in. **$38.50**

**MODEL AS-202** 3 Speaker System — This dramatically effective 3 way system measures 20½ in. x 11⅞ in. x 11⅞ in. and features an 8 in. bass speaker, a 6½ in. mid-range reproducer with a sealed back with a 2½ in. tweeter. Power handling capacity is 20 watts music power .... .... .... .... .... .... **$46.50**

**MODEL AS-330.** A 3-way speaker system with 5 speakers housed in a magnificent, hand finished, oiled teak enclosure. Frequency response is 30-20,000 Hz. Size: 15¾ in. x 11⅝ in. x 26 in. Speaker complement includes a 12 in. bass reproducer, two 6½ in. mid-range speakers, two horn type tweeters. **$98.50**

IMPORTANT: All Sonics enclosures have 8 ohm. impedances. Sales tax is included in all Encel prices.

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Order now for prompt delivery by mail — or call at your nearest Encel Stereo Centre.

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When purchasing equipment from Encel Electronics, be sure to ask for a trade-in valuation on your old equipment. If your old equipment is in good working order, the cost of your current purchase can be reduced considerably. Bring in your amplifier, tape recorder, tone arm, etc. , . . and save more than ever at Encel Stereo Centres!

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We've just made a special purchase of tape splicers . . . and while the stock lasts this easy-to-use unit is priced at anly $2.50. Save time and fidgeting — and frayed nerves; order now!

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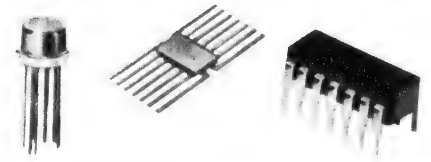
# Mullard Electronic Components for COUNTING



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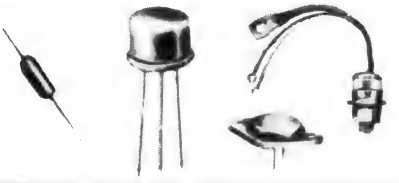

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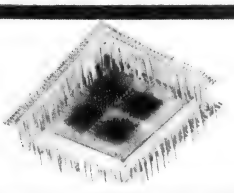

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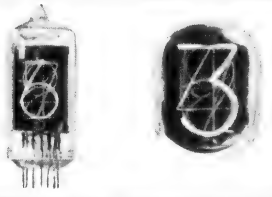

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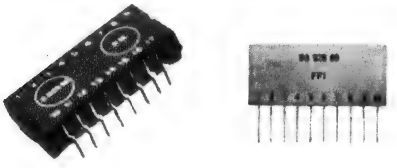
A wide range of devices is available to suit most applications. Special quality characteristics ensure reliability and long life. Most indicator tubes can be obtained with a tinted filter for use under unfavourable ambient light conditions.



**NORBIT 2, CIRCUIT BLOCKS**

Mullard Norbit 2 includes sub-assemblies capable of solving industrial control problems using well established solid state techniques. Silicon semiconductors are used throughout so that an operating temperature range of from —10° C to 85° C is guaranteed, with speeds of up to 10 Kc/s. Each circuit block is a ready-made electronic sub-assembly designed to perform one of the basic functions in digital equipment. The range of circuit blocks includes pulse shapers, gate circuits, flip-flops, amplifiers, etc., to meet the requirements of digital systems engineers.

**APPLICATIONS ENGINEERING SERVICE**

This service operates in co-operation with, and at specific request of, commercial concerns requiring engineering assistance in the application of Mullard products. In addition, answers to technical enquiries are provided by the Technical Service Dept., where world-wide valve and semiconductor references are on file.

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near Hobart, comes from. The Maydena translator is the first in Australia to use a battery power supply, all the others having mains power.

In Northern Tasmania, there is a two-stage translator. Signals from Launceston channel TNT 9 are picked up by a translator at Waratah, which puts them out again on Channel 10. These signals serve not only the people of Waratah and district, but also another translator at Savage River — Luina, which sends them along on Channel 7. Those who prefer a national station can watch the programs of ABNT 3, Launceston, which come over the same route.

Careful husbanding of available television channels has been an even more important consideration in the development of the translator stations than it was in originating stations. By its very nature, a translator station serves only a small number of people, yet it uses up a channel in much the same way as a full-sized station.

The commercial translator at Swan Hill provides a good example of how channels can be preserved. The originating station is BCV 8, Bendigo. Direct reception of BCV 8 signals at the Swan Hill translator is not reliable enough for normal relay purposes, so there is an intermediate low power repeater at Gredgwin, 30 miles south of Goschen, where the Swan Hill translator is sited. To avoid using a scarce VHF channel, the intermediate repeater translates the VHF signal from Bendigo to a UHF channel near 800MHz for onward transmission with a power of 200 watts.

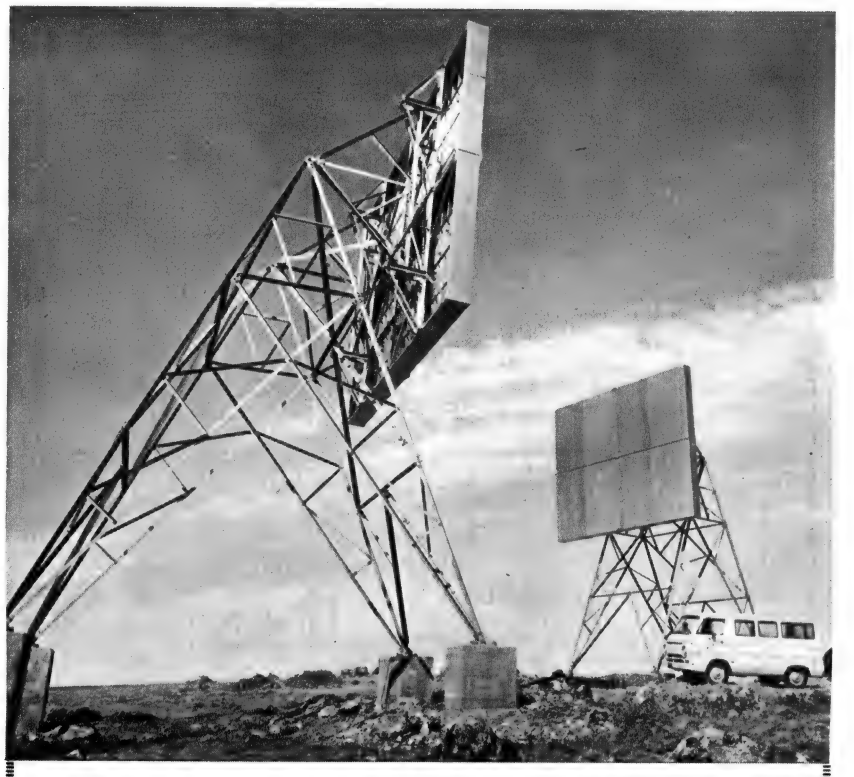
The Swan Hill translator is also an interesting case of co-operation between national and commercial television. There is a 100KW national station (ABSV 2) at Goschen. The translator's low-gain aerial is mounted on top of the national station's 500ft mast. The translator's 1KW transmitter is housed in the national station building, and operated by P.M.G. staff.

Most translator station licences have been isued to the originating station, but there are a couple of interesting exceptions. Presumably in an effort to keep the workers happy, the Snowy Mountains Authority has a 5W translator at Khancoban, and the Northern Electric Authority of Queensland has a 1W unit at its Cardstone Village. It's probably not without significance that they both opted for a commercial rather than a national station.

Translator stations can even be used to serve transitory populations. The Snowy Mountains Authority had a translator at Twin Peaks serving construction camps. When all the construction camps closed down in the middle of 1966, the translator closed down, too.

Providing television for a workforce is relatively uncomplicated when the works site is within reach of an originating station. Some of the booming mining areas of Western Australia are beyond the reach of any kind of television signal at all.

Their needs may be filled by some kind of closed circuit television. For instance, the Mount Newman consortium is reported to be debating whether or not closed circuit television would be worth the expense in its new town near Mount Whaleback. Norseman Gold Mines is also said to be considering some such scheme for the 600 homes around Norseman. ■



# Microwave data link uses passive repeater

A microwave communications system which carries test data between two works plants separated by a mountain range, by using passive repeaters, has been constructed by Lockheed Missiles and Space Company, Sunnyvale, California.

The link connects the Sunnyvale plant with the company's isolated Santa Cruz Test Base, which lie on either side of the Santa Cruz Mountains. The 22-mile link enables Lockheed engineers to run tests at the Santa Cruz plant yet be able to study the results in the main plant as the tests are happening.

"We expect this new data pipeline to be most productive during systems testing of missiles and spacecraft," says Burnell B. Barrick, the company chief of radio planning and control. "Until now, test results have had to be recorded and then telephoned, mailed or transported over 55 miles of winding road to Sunnyvale for analysis. A shortcoming in one of these missiles, or space vehicles, might go unnoticed for days until the data were analysed. The entire test would then need to be rerun.

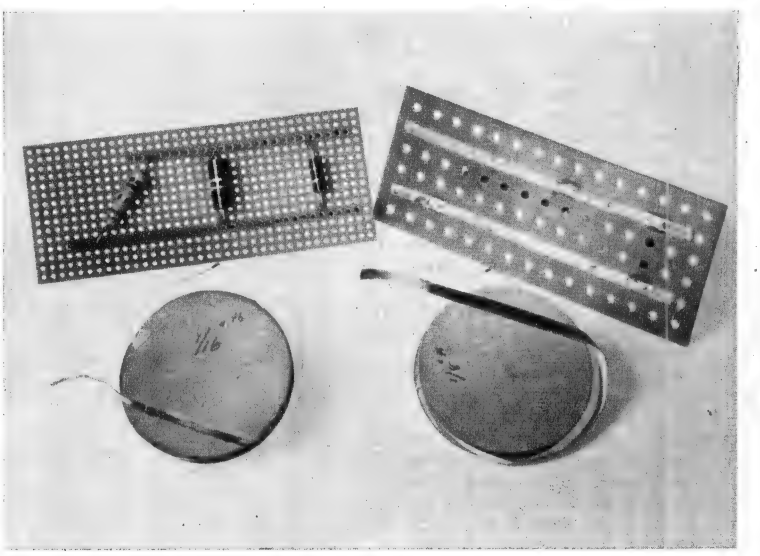
"Now, thanks to the microwave link, tests can be analysed by computer while they are in progress, and adjustments can be made immediately, if necessary, to save reruns."

The system consists of a transmitter-receiver unit and a 10ft diameter "dish" antenna at each end, plus a pair of 14-by-16-foot aluminium "billboard" reflectors at a midway point on top of a mountain. The Santa Cruz terminal is augmented by a short portable link which can be directed toward a particular building or test stand where work is in progress.

As automatic devices at Santa Cruz put a vehicle or component through its tests, data in the form of telemetry signals are fed into a transmitter. The signals are transmitted in microwave form—high-capacity radio waves focused into a pathway about one degree wide.

The concentrated microwave beam is directed towards one of the metal "billboards" situated on the mountain range about halfway to Sunnyvale, and is reflected towards the second close by. The second reflector alters the direction of the beam once more, so that it is in the right direction to strike the dish receiving antenna at the Sunnyvale plant. The two reflectors are required, instead of one, because the required change of direction of the beam is small, and effective reflection of the beam could not be achieved at the shallow angle at which a single reflector would have to be placed.

At the same time as data signals are being received at Sunnyvale, control signals are travelling in the opposite direction, on a different frequency. ■



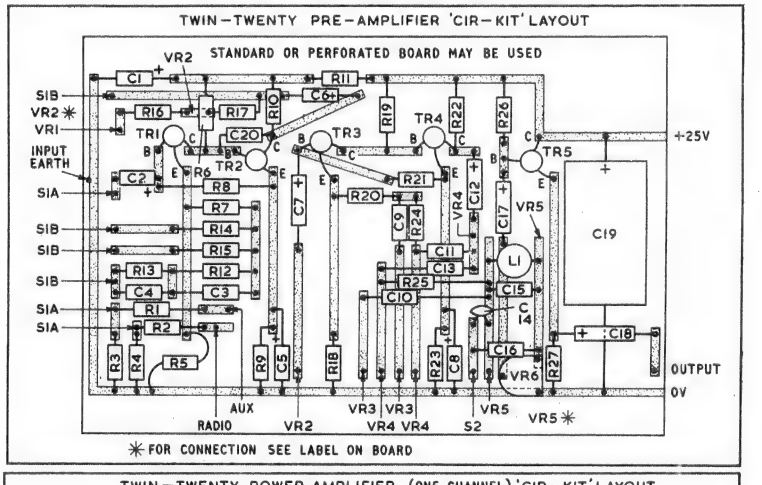
# INSTANT CIRCUITS

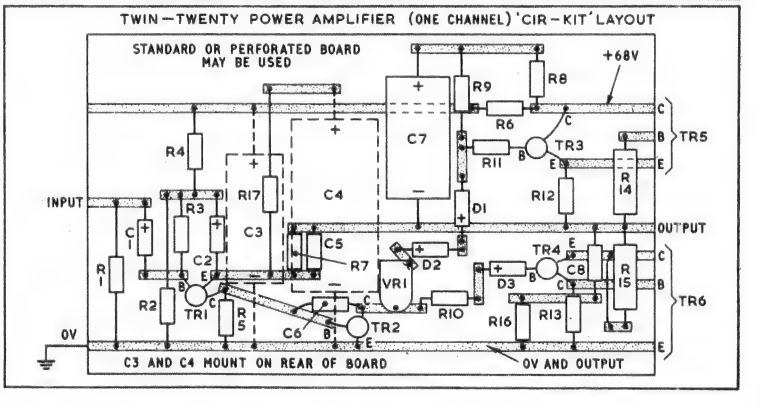
## A new method of making component boards using self-adhesive copper strip.

DESPITE the initial reservations felt by many people, particularly with reference to servicing, the printed circuit is now firmly established in most types of electronic equipment, ranging from the incredibly cheap pocket radios that have flooded the country in recent years, to some of the most sophisticated professional equipment available. Its origins lie in weaponry — a heritage unfortunately common to many good "electronic" ideas, but printed circuitry is, and indeed has been for some time, an attractive system for the amateur who constructs his own equipment, for it solves the mechanical problems of component mounting and eliminates the chores of wiring — as well as facilitating a neat and workmanlike job. For the amateur who has so far shied away from etching his own boards, a new system is now available, which is both economical and easy to use, yet with care, is capable of excellent results. Known as **Cir-kit,** the system utilises bakelite boards, similar to those used commercially, in conjunction with self-adhesive copper strip. This is 1/16in or 1/8in wide — easily cut with scissors or a model knife — and attaches to the boards rather like a piece of **Sellotape.** The adhesive is very efficient, although the bond is not quite as good as that on pre-laminated boards — which means that care is needed when soldering not to overheat the copper. However, anyone who is competent to solder a transistor or capacitor without causing damage should have no trouble, and the adhesive improves with aging, so that long-term stability is satisfactory. Layouts can normally be planned using the theoretical circuit diagram as a guide, and boards may be pre-punched or drilled according to requirements. With the pre-punched board, the strip can either be laid over the holes, and then punched through with a small drill or a watchmaker's screwdriver, or it can be laid alongside the holes and component leads are inserted through the board, folded over and soldered (see photo). The former method permits a more compact layout.

A few tips on planning layouts. Always be sure that the component spaces you allocate are adequate — it is preferable to purchase the bits before embarking on this task, although capacitors are available in literally dozens of shapes for board mounting and resistors are more or less of standard size, dependent on ratings. Avoid siting adjacently on to your layout components which are in different stages —as this can lead to instability. If instability does occur, of course, **Cir-kit** does permit alterations to be made, although it is as well to investigate the problem before redesigning sections of the board for it may not prove necessary.

The excellence of the system, however, lies in its versatility, for it enables the home constructor to produce a wiring board on a one-off basis for most of the circuits described in this and other journals, and while it will no doubt encourage many to "try their hand," it will also enable many who already build their own equipment to achieve neater, more reliable results with a minimum of fuss.

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# Technical Review

## Electron Beam Cures Paint Films in One Second

Curing paint films in industrial processes is a massive problem for many manufacturers, involving large plant and lengthy procedures. A new electron beam process for curing paint films in less than one second with relatively small plant is described in this article by Arthur Smith, science correspondent, London "Daily Mirror."

Industrial coating plants are normally based on the curing of organic finishes by the application of heat, sometimes with the addition of catalysts. The main snags are the need for long ovens, which may be up to 200 feet long, consume large amounts of energy and which are difficult to keep clear of dust while the paint is wet or tacky; the possibility of damage to heat-sensitive base materials; and the cost of expensive solvents.

Now, two British companies, Tube Investments and Porter Paints, have combined to produce a new system which will enable paint films to be cured within a second. The method used is the application of electron beams to cure surface coatings. It has been known for many years that irradiation of suitable polymers can produce cross-linking at room temperature and the process has been applied commercially to the curing of plastics such as polythene in film.

The equipment for this was not suitable for the treatment of thin surface coatings, and most of the usual coating materials of known performance were not generally amenable to it.

For 10 years the Tube Investments Research Laboratories at Hinxton Hall, Cambridge, have been investigating the use of electron-beams to cure coatings. Earlier work with a Van de Graaf accelerator showed that relatively low-energy electrons, below about 250KV, could be used if the problems of designing suitable equipment could be overcome. The emphasis at this stage was on metal finishing and Drynamels Ltd., the Tube Investments paint company, carried out considerable development work on coating materials and a process was patented in 1960.

A pilot coating and curing line, known as TIGER (Tube Investments Generator for Electron Radiation) was built at Hinxton Hall, in co-operation with British Aluminium Research Laboratories. This confirmed the early promise, but there was still plenty of work to be done, particularly on the development of organic materials which could cure when subjected to economical dose rates and which would adhere well to metals.

A "window" was designed which allowed a concentrated electron beam to pass from the vacuum chamber of the accelerator to the atmosphere and on to the coated surface, while withstanding the external air pressure over a large area. Porter Paints and Tube Investments have now reached an agreement for the commercial exploitation of the process. Under this agreement the TIGER facility was installed at the laboratories of a Porter associate company, Sisson Bros., at Hull, in Yorkshire, and experimental work on special coating materials is going ahead. TIGER will be used as a simulator to provide the data for full-scale commercial plants.

There are three main units: an application section, the electron-beam irradiation unit, and a conveyer system to carry the workpieces through the system at appropriate speeds.

The workpieces are rectangular hardboard flats, up to 18in long and 6in wide. They are fastened to trolleys mounted on rails and propelled by a belt friction-drive. Over a few feet the trolleys are accelerated rapidly to speeds varying from around 200ft/min to 2000ft/min.

Most of the work is based on the use of a curtain coater for applying the coating material. Paint flows out of a cylinder through a slot, dropping in a sheet, and the workpiece passes through this to receive a clean film of paint. After the coating, the trolley speed is automatically adjusted to the appropriate curing conditions for the coating involved. It passes beneath the accelerator, in which electrons are emitted from a heated tungsten rod cathode, which is held at about —130KV, and accelerated toward an earthed anode at the chamber base.

After irradiation, the workpiece can be picked up immediately.

No radioactive materials are involved in the process. The electron beam itself has a range of only a few inches in air, but secondary X-rays are produced when the electrons are absorbed in the irradiated materials. However, they are of relatively low energy and are contained by lead shielding.

Porter Paints have already developed a wide range of materials suitable for use in the process. So good has the progress in this direction been that it is now a practical hope that finishes with the performance of stove enamel can be produced.

The electron-beam process has many advantages including speed, dust-free products, absence of heat, low power cost and a great saving in space. The immediate development on which work is now going on is the design of a full scale plant. The process is believed to be the most important advance in industrial finishing techniques for many years. ("Spectrum," No. 54.) ■

*A workpiece emerging from the shielding door fully cured after being exposed to the electron beam for less than one second.*

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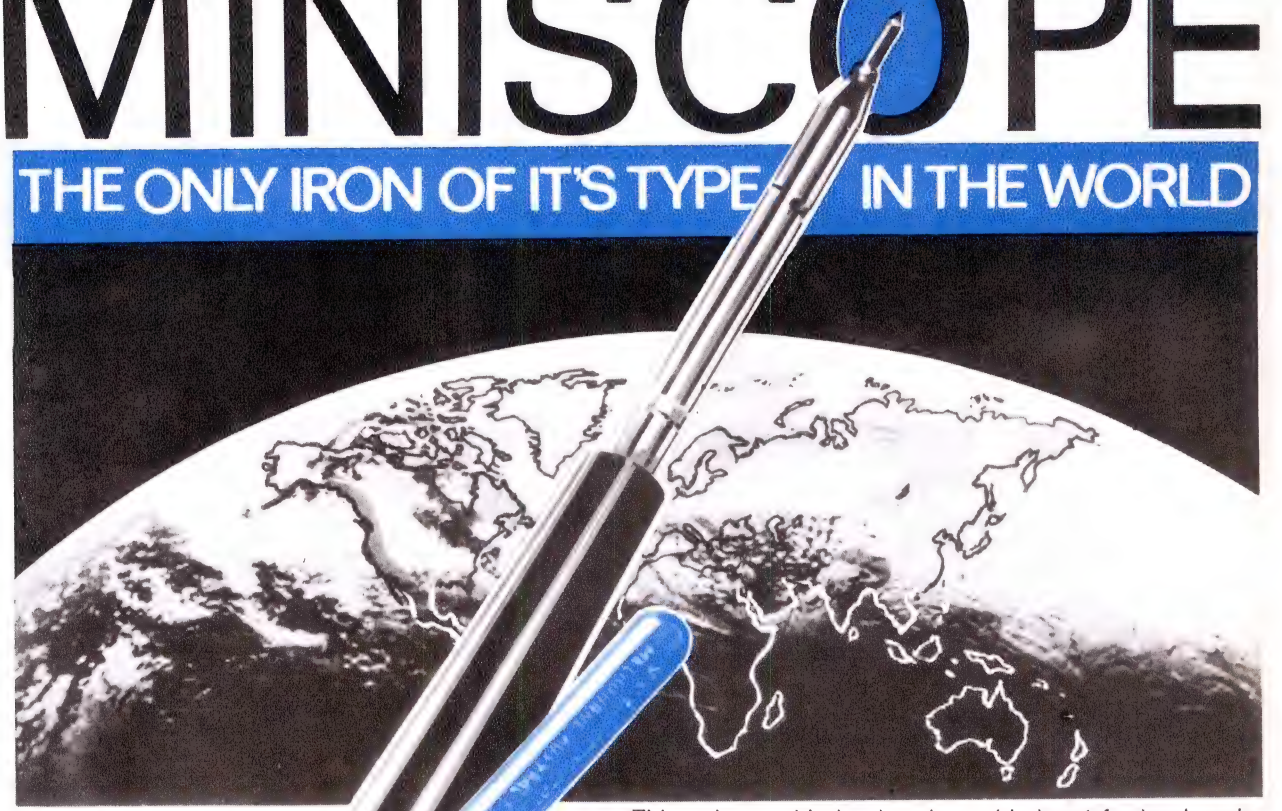

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# Night vision goggles with inbuilt image intensifiers

Miniature image intensifier devices small enough to build into night vision goggles are expected to be available to U.S. Armed Forces in the not too distant future.

A glass disc resembling a thin fibre-optics plate with the cores etched out will make the second generation of night-vision instruments smaller, simpler, lighter, and less expensive than the present devices. Placed in an image intensifier tube, the disc, called a micro-channel plate (MCP), exhibits an electron gain that enables a single amplification stage to do the job that now requires three stages in low-light-level devices.

The first contract for second generation devices, a $4.8 million Army order, was awarded in late July, to the ITT Industrial Laboratories in San Fernando, Calif. ITT is to deliver 650 sets of night-vision goggles plus 700 replacement tubes; the contract is classified, but the tubes are reportedly the size of a small coin. Robert Ferraez, project manager at ITT, will say only that the goggles will replace the 18-ounce AN/PAS-5 types, which are a little more than 3 inches long and operate with infrared light.

The resemblance of the MCPs to fibre-optics plates is only structural. Electronically, microchannel plates behave like an array of single-channel multiplier tubes shrunken to microscopic size. These glass multiplier tubes, used in satellites to detect radiation, are about 40 mils in diameter and a few inches long, and have an electrode at each end. A field-gradient voltage creates a longitudinal electric field that pulls electrons down the tube, knocking loose secondary electrons from the walls as they go. The swelled number of electrons reaching the far end of the tube produces gains of from 10,000 to 10 million. Gains of the MCPs are comparable.

Developmental work directed at reducing the single-channel multiplier to a microscopic array 1 to 3 millimeters thick has taken nearly seven years. But now at least three companies—the Rauland division of Zenith Radio, the Mosaic Fabrications division of Bendix Corp., and the Palo Alto Tube division of Varian Associates—have succeeded in making the plates on a production basis. Varian is a comparative newcomer to the field, having started its work in April, 1967. Bendix had R. and D. efforts of its own in this field until it bought out Mosaic.

In a practical night-vision device, the MCP will be placed between the photocathode and the phosphor screen. Electrons knocked off the photocathode will be multiplied in the MCP and accelerated by an electrostatic field to excite the phosphor. With many more electrons hitting the phosphor in this arrangement than in first-generation devices, only a single stage is needed to magnify light some 40,000 times.

Because each tube in the array delivers, in effect, a bundle of electrons to the phosphor, tube diameter determines the resolution of a device made with an MCP. For this reason, the hole size and the length-diameter ratio (which determines gain) are classified. Loosely, hole size is comparable to that of a single optical fibre, and the ratio is comparable to that of a single-channel multiplier. There are more than a million holes in a 1-inch-diameter plate with a surface area of more than 850 square centimetres.

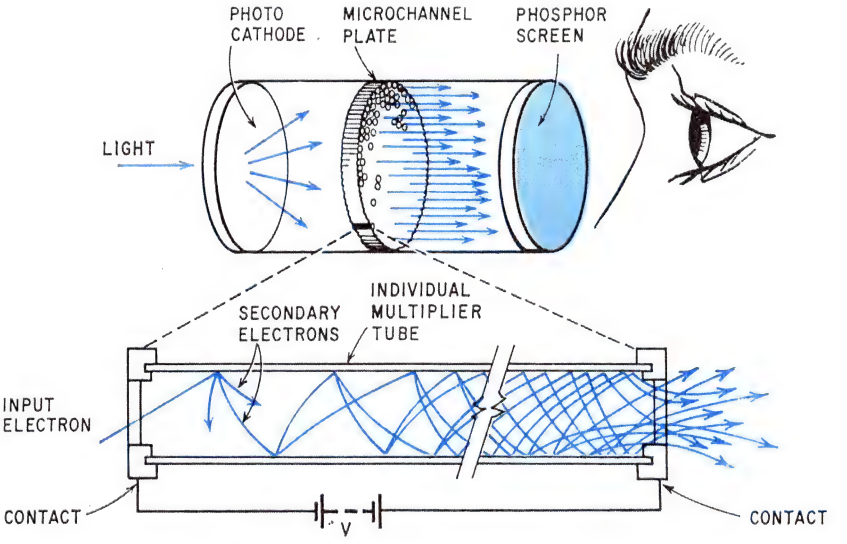
Dominic Ruggieri, MCP manager at Varian, describes the first stages of array manufacturing as similar to those used in the fabrication of fibre-optics plates. A glass core is inserted into a tube about an inch in diameter; the tube and core have the same index of expansion so that together they can be heated and drawn out into a small rod. The rods are chopped off in 1-foot lengths, then bundled together and drawn out again. Lengths from the second drawing are also bundled and heated into a boule from which the plates are sliced.

Here, says Ruggieri, the MCP and fibre-optics processes part company. The core of a fibre-optics plate is used to transmit light; in an MCP, it merely keeps the tube from collapsing during the drawings and is therefore etched away at this point.

Then, in the most sensitive part of the operation, the insides of the tubes are coated with a few angstroms of dielectric oxide. This coating, the source of the secondary electrons, also serves to keep the electrons moving down the tube by varying the electric field. Metal contacts are then evaporated over the faces of the disc.

Varian expects the industry next year to sell 3,000 to 6,000 MCPs at a price of $100 to $150 per plate, all to the military. From 1970 to 1975, the company puts the military market at some 300,000 plates, but it also sees civilian use of MCPs in X-ray image intensifiers (to reduce the amount of X radiation required) and in some new chemical-filtration and electronic-display applications.

In some fast-writing cathode-ray tubes, Ruggieri notes, a single-shot scan doesn't deliver enough current per unit time to activate the phosphor. Though an MCP could increase the number of electrons hitting the screen, present plates have such high resistance that they couldn't take the heat. Ruggieri suggests that what's needed for this application and for chemical filtration are ceramic plates fabricated with entirely new techniques involving micro-drilling. ■




*The basic elements of the proposed night vision instruments. The spacing of the individual elements in the top diagram has been exaggerated for the sake of clarity.*

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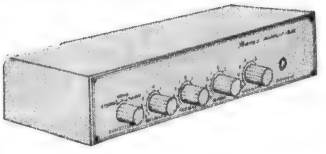

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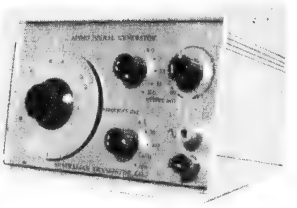

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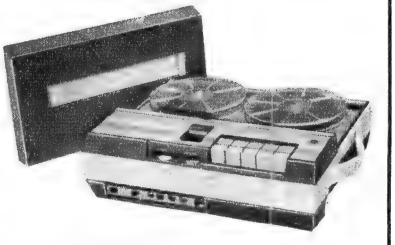

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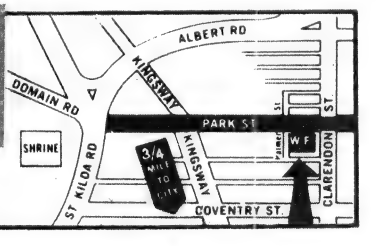


# "Piccolo" — the sad story of a teletype system nobody wanted

"Piccolo", a Morse transmission system developed by the British Diplomatic Wireless Service, is to be marketed on a worldwide basis by The Marconi Company after being ignored for nearly 20 years by U.K. electronics companies.

Piccolo is a unique multitone teleprinter signalling system that can outperform any technique so far implemented in terms of taking traffic over noisy, interference-prone radio circuits from signals down to four decibels below the noise level: a system which provides good copy from signals that a manual operator could hardly find, let alone read. HF signals in the region of 0.1 microvolt, so that "signals inaudible — Piccolo printing" has become a routine report: a system offering some six times the accuracy of Morse on ultra weak circuits — at 10 times the speed.

This remarkable system has been devised and developed by the Diplomatic Wireless Service (D.W.S.) of the Foreign Office over a period extending over 20 years — as the original patents testify.

Basically, the system uses 33 tones at 10Hz intervals, from 320 to 660Hz, each of the 32 tones being alloted to one teleprinter character and transmitted for the full duration of the character period; and, additionally, one standby tone.

At the receiver, the tones are applied to very high Q resonant circuits, using pot cores and Q-multiplier techniques. All circuits are sampled by a voltage comparator and then quenched at the end of each 100mS period (or other period appropriate to the band rate used). The resonant circuit concerned integrates the entire signal energy received over the 100mS period, and so builds up a sawtooth waveform. It can be shown that all other circuits will have near zero energy at the time of sampling. Absolute voltage levels are unimportant.

The system is synchronous but uses standard start-stop teleprinters for print out and five unit code input. Transmission at 100wpm can result in less than 0.2 per cent error rate when the signal is 4dB below noise level in a bandwidth of 470Hz.

The basic principles were first demonstrated to industry in the early fifties in the form of an experimental 15-channel multiplex unit intended for use on LF circuits that never, in fact, went into operational service — but showed that the team were working on sound lines.

Even as a compact single-circuit terminal, it has a history of almost 10 years, with practical realisation from the late fifties. Today more than 40 Mark 2 terminals are churning out traffic in many parts of the world — providing the desirably clean copy that prevents Foreign Office cypher machines from clogging up.

Embassies in Delhi, Rawalpindi, Tehran, Ankara, Moscow, a number in Africa — and at the important D.W.S. relay station on St. Helena — have Piccolos working every day, with a communications efficiency on modest power transmissions that was never achieved with conventional teleprinter techniques or manual Morse.

In a recent, previously unrevealed, test of HF communications aboard Queen Elizabeth, Piccolo was worked, with an improvised diversity aerial arrangement, every night to copy some 300,000 characters with just two errors.

The system would seem to represent a significant step toward the long-sought automation of HF operation. Combined with another D.W.S. technique — "Piccabel" — it can provide selective calling to an unattended terminal over long distance circuits, to give auto-alarm or allow traffic to be sent safely in the absence of a duty operator. A two-letter calling tape run from the control station for a few minutes actuates the distant station at signal strengths down to the weakest Piccolo levels.

Piccolo represents a totally different approach to forward-acting error detection and correction systems—concentrating on providing good copy at normal signalling rates rather than correcting errors. It would seem to have advantages over both these approaches—at least for some important classes of HF operation. Like many other good developments, it sprang almost from "black-market" research in a tiny laboratory, with the project not officially funded until about 1958.

D.W.S. were following the classic Oliver Heaviside precept: "The best proof is to go and do it." Build a better mousetrap and the world will beat a pathway to your door. Certainly, over the years, D.W.S. have demonstrated the system to just about everyone in the communications field. They have come, have complimented the D.W.S. team—or, in the early days, just swallowed hard at trying to understand this practical concept of information theory at a time when it was little known; sometimes they have done some further probing.

Yet, once they discovered that there was no suggestion of a government R and D contract, or an immediate assured market they have usually lost interest.

Many and varied have been the reasons given for this lack of interest: high stability requirements, bandwidth, lack of compatibility, inflexibility, need for much more engineering development . . .

Many of the early "objections" to Piccolo have been overtaken by continued development either by D.W.S. or by communications technology generally, though of course it still needs to be installed at both ends of a circuit.

To get optimum benefit with SSB systems having fully suppressed carrier, the receiver should preferably have a stability of the order of 1Hz—today, this is within the state of the art.

New accessory units have been developed, making the system more flexible in meeting the needs of other potential users—for instance, adapters to convert the output of standard teletype keyboards to the Piccolo mode, to make possible remote operation over telephone lines, or to permit operation from standard teletype tape readers.

No longer can it be claimed that Piccolo is not fully engineered. Costs are known within reasonable limits — and a complete send/receive terminal (with its in-built facility of diversity operation where required) would cost in the region of £7,000.

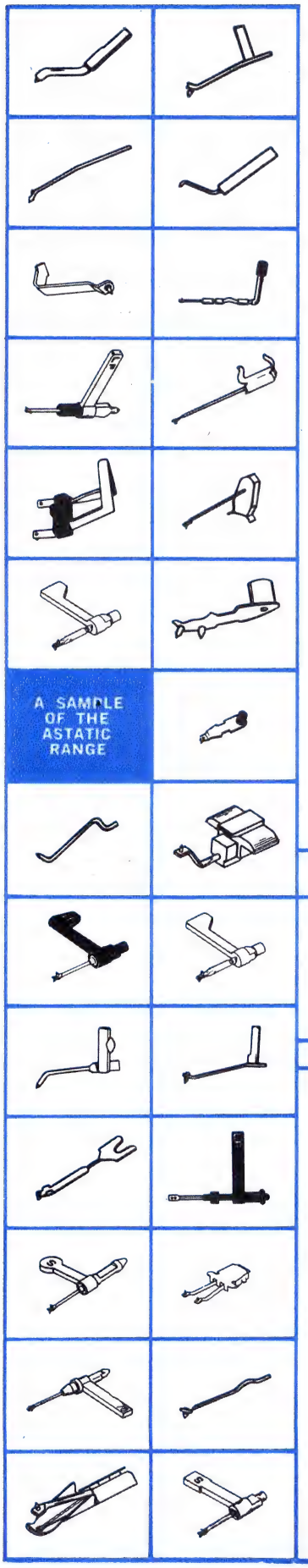
Yet over the years, D.W.S. have seen the possible benefits to Britain of industrial exploitation slowly fading away. Patents taken out in most major communications countries are expiring. A few can be renewed on grounds of non-exploitation, but not all.

Originally it had been thought that industry would seek to acquire the patent rights, or manufacturing licences, or the purchase of engineering know-how. At one stage, Plessey took out an option to manufacture, but let it lapse.

D.W.S. have always had a sturdily independent attitude towards other people's equipment — buying where the product suited them, inheriting much American equipment, and not developing the type of industrial relationships where someone might have taken up Piccolo as a quid pro quo. But why should not the system have stood in its own right?

Now, at last, there are plans by The Marconi Company to market D.W.S. built Piccolo terminals on a worldwide basis, with a demonstration system to be installed at Chelmsford to show prospective users. There still seem some lingering doubts whether these admittedly specialised equipments can be sold to carriers or organisations having control of only one end of a circuit.

Industry is thus at last taking a paddle, if not a plunge, with future plans still depending upon waiting to see how it goes. Meanwhile the majority of potential users — maritime, aviation and other point-to-point circuits, military HF, diplomatic and similar networks — may well jog along striving for ever higher transmitter powers to blast through conventional signals in ever increasing interference. ("Electronics Weekly," 2/10/68.) ■

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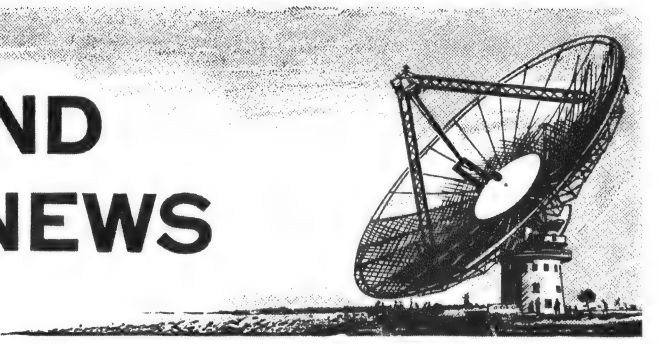
# SCIENTIFIC AND INDUSTRIAL NEWS



## Second earth station for Carnarvon

The Overseas Telecommunications Commission (Australia) is to establish a second satellite communications earth station at Carnarvon in Western Australia. The total cost will be about $3 million, including the cost of site works, power supplies, equipment for the terrestrial link, spares and test equipment. The major contracts have been awarded to the same Japanese companies as for the Ceduna, South Australia, station due for completion this year. (See "Electronics Australia," October, 1968, for details of the Ceduna contracts and for a picture of the antenna system to be used at Ceduna and at Carnarvon.)

The O.T.C. recently received a contract from the International Satellite Consortium (Intelsat) to provide telemetry tracking and command facilities for the global satellite communications system. Until the second Carnarvon station is completed, Intelsat and N.A.S.A. will share the existing station. When the new station is built, Intelsat will use the existing station exclusively while N.A.S.A. and public international telecommunications traffic will be provided by the new station working with an Intelsat III satellite to be placed over the Pacific Ocean early in 1969. The new station is expected to be in operation towards the end of 1969 to coincide with the completion of the east-west microwave link across the Nullarbor and a coaxial link between Perth and Carnarvon.

## Increased telecommunications exports

Australian manufacturers exported nearly $10 million worth of telecommunications equipment and components in 1967-68 —nearly $3½ million more than the previous year—according to the annual report of the Australian Telecommunications Development Association (A.T.D.A.) Customers included New Zealand, Britain, the U.S.A., Canada, West Germany, Belgium, Luxemburg Fiji, Singapore, Malaysia, Thailand, the Philippines, South Africa and Spain. The report says Britain's accelerating military withdrawal from east of Suez has helped Australian exporters, as some of Britain's former customers in South-East Asia are tending to buy more of their requirements in their own area.

In 1967-68, the Department of Supply placed orders for $13.7 million worth of equipment for defence departments with Australian telecommunications and electronics manufacturers — $2.8 million more than in 1966-67. It also made purchases for foreign aid and sponsored a number of research and development programs.

## Missile guidance

An order worth several million pounds sterling has been placed with The Marconi Company by the British Ministry of Technology for television guidance systems for the first production batch of Anglo-French MARTEL guided missiles. A small sensitive television camera, carried in the nose of the missile, provides a high quality picture from which any type of target can be positively identified. It gives the observer in the aircraft a direct, visual identification of the target, enabling him to steer the missle accurately on its final course, without the launching aircraft coming within visual or radar range of the target.

A joystick control allows the observer to adjust the field of view of the camera. Control signals are then generated within the missile to align the flight path with the axis of the television camera.

## Computer ordered by Victoria

The Government of Victoria has ordered an ICL 1905 E computer system valued at almost $1 million from International Computers Ltd., of England. The computer complex will be installed late this year in the Tower Building, which is the second stage of the new public offices under construction in Treasury Place, Melbourne. The computer will be operated by the Victorian Public Service Board's Electronic Data Processing Centre as a service to all departments of the State Government. In addition to a large internal memory, the computer will have both paper tape and punched card readers, two high speed printers, and a mixed storage capacity of six magnetic tapes and an exchangeable magnetic disc store.

## Nuclear piston engine

The combination of a Stirling heat engine and a nuclear reactor has definite thermodynamic advantages for future power stations and promises a highly compact plant, according to a recent paper by Professor Kolin of the Zagreb University, Yugoslavia. The Stirling engine operates on a closed cycle with a fixed amount of working gas cycling continuously between two pistons reciprocating on the same shaft. Heat is added to the working gas through a heat exchanger, and it expands against the main piston to do work rotating the shaft. The nuclear cycle would replace the heat exchanger with the core of the reactor; the working gas would circulate on direct cycle between the core and the engine.

## Programmed inspection probe

*A three-axis numerically controlled inspection probe developed by the Lockheed-California Co. checks the accuracy of an aircraft main frame section only seconds after milling of the part in the company's machines shop at Burbank, California, U.S.A. The device, called an "X-Y-Z" probe, is said to reduce inspection time by 40 to 1 over conventional methods. The probe is installed in the spindle of a numerically controlled milling machine and performs inspection of a part under control of the program tape with the part still resting in the machine. With conventional inspection methods a part is removed from the milling machine, placed on an inspection table, and then gauged manually. Lockheed has adapted an electronic transducer to replace pneumatic pressure, used in the prototypes, to measure probe displacement.*

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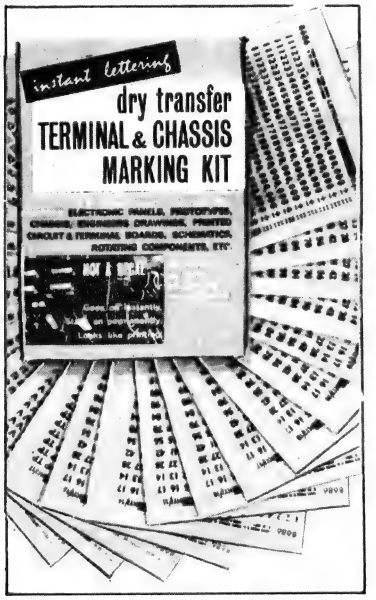


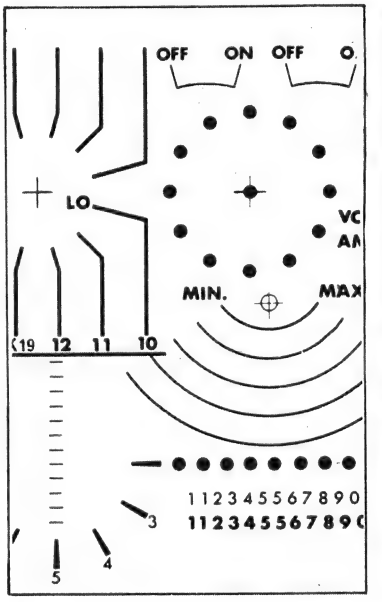


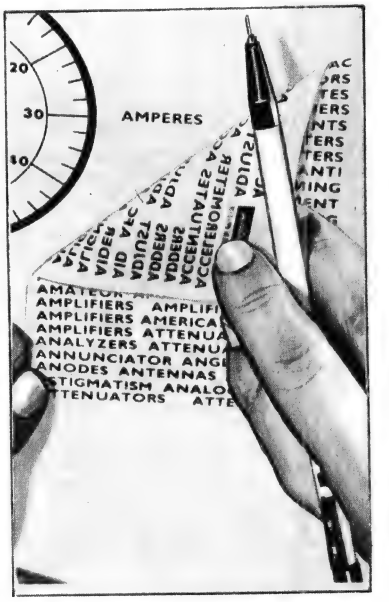


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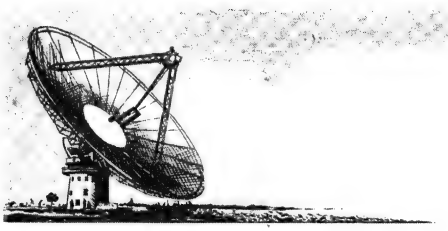
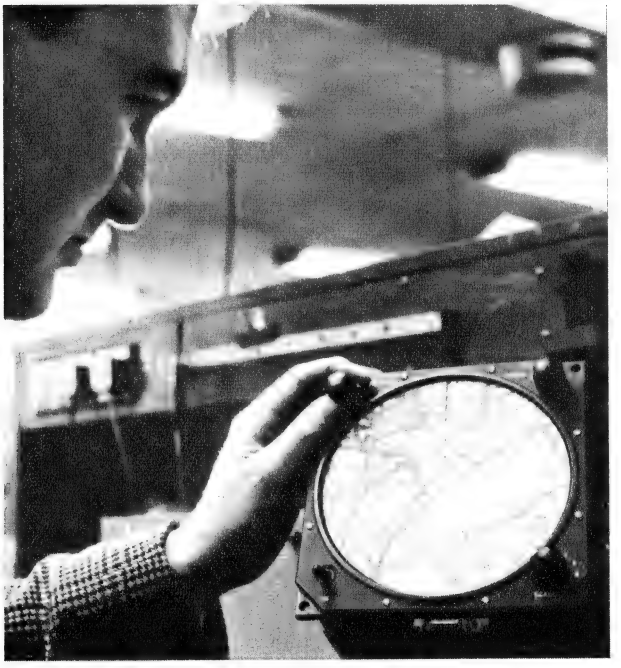


## Airborne moving map



*This airborne moving map radar will give airline pilots a completely automatic tracking system capable of covering normal world routes. The equipment, called the Marconi Moving Map Equipment AA6712, projects a reel of filmed map, in one of four scales, on to the display screen. The computed position of the aircraft is shown in the centre of the screen, and the filmed map moves beneath the spot enabling the pilot to see the actual position of his aircraft relative to the required track.*

## Satellite repairs

The General Electric Co. of the U.S.A., under a U.S.A.F. contract, has specified a system for carrying out repairs on satellites by a mechanical tool controlled from Earth or another spacecraft. The projected system would comprise two slave arms and hands, a co-ordinated television system and a telemetry control system on a satellite carrying a variety of tools and spares. The operator would manoeuvre the slave satellite into position by remotely firing directional thrusters. The television system would allow the operator to control the hands in a similar way to those used in radioactive environments. The GE engineers are working to overcome the problem of the time lag between the operator and the space tool.

## National newspaper printed on QE2

For the first time ever on a ship at sea, the new Cunard QE2 will provide passengers at breakfast time with an up-to-the-minute edition of a national daily newspaper, the London "Daily Telegraph," printed on board the liner. The first edition of the QE2 "Daily Telegraph" came out during acceptance trials towards the end of 1968.

The Marconi Company has supplied and installed a radio system, known as Piccolo, (see "Technical Review," this issue) designed to give error-free transmission of news material to the line. The system, developed and manufactured by the British Diplomatic Wireless Service, is used with conventional, high-quality radio receivers to enable messages to be accurately received at signal strengths and interference levels which would prevent any normal speech or telegraph messages from being received at all.

## Skynet telegraphy equipment

A 12-channel, time-division-multiplexing telegraph system is being supplied by the Plessey Group to the British Ministry of Technology for use in the Skynet military satellite communications system. The equipment, developed by a Plessey subsidiary, British Telecommunications Research Ltd., is capable of multiplexing a mixture of start stop and synchronous telegraph signals of different speeds and formats. Silicon IC logic techniques are used throughout, and a robust construction makes the equipment suitable for transportable installations. Facilities for automatic synchronisation, supervision and alarm indication are provided.

## Giant submarine cables

Three submarine cables, said to have the largest capacity in the world, are to be laid from Britain to Belgium, the Netherlands and West Germany in 1971 and 1972 under the British G.P.O.'s five-year expansion plan. Each cable will carry 1,260 circuits, with two-way transistorised repeaters at intervals of just over seven miles. The overall cost of the three projects, about $A8 million, will be borne pro-rata by the British, Belgian, Dutch and German authorities.

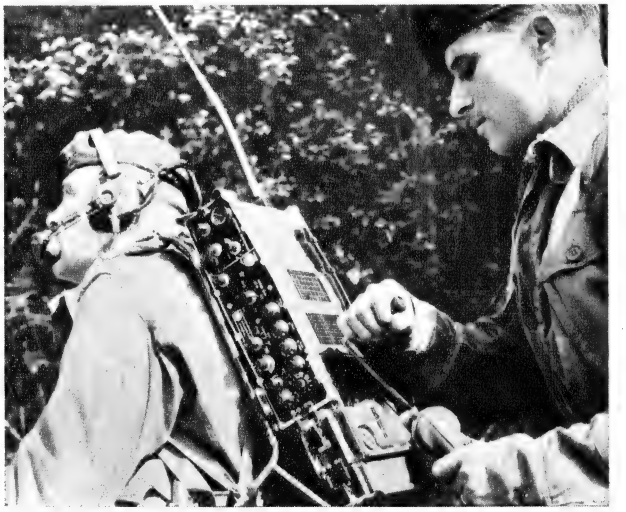
## Centrifugal electric field

Mr J. W. Beams, a researcher at the University of Virginia, U.S.A., has detected a small electrical potential in a rapidly spinning metal rotor, due to the centrifugal forces acting on the electrons. His apparatus consisted of an aluminium alloy motor, 15cm in diameter, spun inside a vacuum chamber by an air-driven turbine supported on air bearings. He measured the electrical potential by using capacitor plates near the centre and at the periphery of the rotor, which formed the second half of the capacitor in each case. Beams observed a radial potential difference of a few microvolts for speeds of several hundred revs per second. This voltage was roughly proportional to the square of the speed and independent of the direction of rotation.

## CCTV boiler flame viewing

The Marconi Company is to supply three closed-circuit television camera channels for a new 125MW extension to the Korangi Power Station, near Karachi, in West Pakistan. The equipment for the installation will comprise vidicon cameras type V321, two of which will be housed in water-cooled housings for continuous boiler flame viewing. The third will be used in conjunction with a boiler-drum water-level gauge attachment to give an unambiguous indication of the boiler-drum water level. The pictures from the three cameras will be displayed on a 14in picture monitor in the central control room.

## SSB manpack radio



*A single-sideband manpack radio, known as the B20, is being developed by the Plessey Electronics Group in the U.K. for the British Army. The equipment consists of a transmitter-receiver unit with integral antenna matching circuits, a carrying frame, rechargeable battery, an 8ft whip aerial and audio equipment. The total weight is less than 20lb because of the extensive use of micro-electronic circuits. Channels are at 100Hz intervals over the frequency range of 2-30MHz, thus giving 280,000 channels.*

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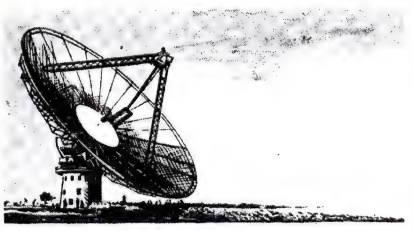

## "Warmer" superconductor

For the first time a compound has been devised that will become superconducting at a temperature above the boiling point of liquid hydrogen. This is regarded as an important step towards large-scale practical use of superconductors, as liquid hydrogen is cheaper and more efficient than helium as a coolant. A team from the University of California, San Diego, and Bell Telephone Laboratories, New Jersey, reports an intermetallic compound of niobium, aluminium and germanium with a transition temperature between 20.5 and 21.0 degrees K.

One of the team, Dr B. T. Matthias, believes there is every chance that further refinement of the structure of the intermetallic system will give transition temperatures in excess of 22 degrees K. (Proceedings of the National Academy of Sciences, Vol. 62, page 621).

## Ultra-clean room

A suite of clean rooms recently brought into use at the Mullard Research Laboratories, near Redhill, Surrey, England, is believed to be the cleanest in the British electronics industry. During rigorous tests a particle count was taken several times a day for a week. At no time did the number of particles bigger than 0.3 microns exceed one per cubic foot. In many clean rooms, less than 10,000 particles of 0.5 microns per cubic foot is regarded as good. (A full stop on a typewriter is about 800 microns in diameter).

The suite, used to produce masks and slices for experimental circuitry, consists of two ultra-clean rooms enclosed within an existing clean room. One of the walls of each inner room is composed of filters to trap particles larger than 0.3 microns. Mounted behind the filters are eight fans, while the opposite wall is made up of slatted exit ports. The enclosing clean room contains air that has been filtered to exclude particles larger than five microns.

## Microwave diodes

Two Japanese companies, Hitachi Ltd. and Nippon Telegraph and Telephone Public Corp. (NTT), have developed a special purifying process which increases the electron mobility in gallium arsenide crystals to a level close to the theoretical limit. This affects the time taken for electrons to travel through the crystal of a diode base, which in turn limits the frequency response.

In practical experiments, a GaAs Gunn diode was used as an oscillator replacing a conventional klystron. During 8500 hours of continuous operation, the GaAs device achieved outputs of 150mW at 13GHz and 250mW at 10GHz. The higher electron mobility also lowered the noise of the Gunn diode, both in FM and AM. The Gunn diode also had a better thermal characteristic than the klystron with a figure of 160KHz per degree C at 13GHz.

## Telephone directory on microfilm

All 300,000 entries in the Manchester, England, local telephone directory have been put on microfilm for a set of trials. Operators are using two different types of microfilm viewers in the trials, one using manual and the other pushbutton selection. In the first, all the directory entries are on a single transparency about the size of a postcard. The pages of the directory have been reduced to oblongs about one-sixteenth of an inch across, arranged in rows. To find a number, the operator first slides the transparency up or down under a viewer to find the correct row, then slides it sideways until she has the right page.

In the second system, a similar type of operation is carried out automatically in two stages. This uses a number of transparencies, each carrying part of the directory. The operator first selects, by pressing an index button, the transparency containing the wanted surname. On the transparency is an index which indicates which second stage buttons she must press to obtain the required page. The trials, in which the two systems will be compared with the existing service using directory volumes, are intended to weigh the prospects of using microfilm to make possible a faster and cheaper directory inquiry service.

## Electronics conference

An International Electronics Conference, sponsored by the Canadian Region of the I.E.E.E., will be held in Toronto, Canada, on October 6-8, 1969. The Technical Program Committee has called for 20-minute papers on electronics and related subjects. The title and a 100-word abstract, including name of author(s), company affiliation and telephone number, and a 500-word summary (or equivalent material suitable for reviewing the paper) should be received by the committee by March 15, 1969. The abstract and summary should be sent to Dr Rudi de Buda, Technical Program Chairman, International Electronics Conference, 1819 Yonge Street, Toronto 7, Canada.

## Carrier system for ETSA


*A modified version of this carrier telephone equipment has been ordered by the Electricity Trust of South Australia from Philips Telecommunications of Australia Ltd., Alberton, S.A. The multichannel system will form part of the control supervisory and telemetry network operating from the East Terrace control centre to control the Adelaide Metropolitan Power Transmission network. It will operate over microwave radio relay links, and both the equipment and transmission routes will be duplicated for greater reliability. Each terminal will be self-contained on its own rack, and will incorporate channel modem, group modem, supergroup modem, carrier supply and power supply equipment.*

## Australian computer exports

The chairman and managing director of Information Electronics Ltd., Mr Malcolm Macaulay, has been investigating export markets for the new computer his company is now manufacturing in Australia. He visited the U.S.A. during late 1968 where he had discussions with a number of firms seeking licences to market the computer in the U.S.A. He also met the principals of several leading universities and educational institutions interested in buying the computer. In San Francisco, Mr Macaulay delivered a paper on the IE 10000 computer and input-output terminals for the computer at the 1968 Fall Joint Computer Conference.

Information Electronics began production in January, 1969, of the IE 10000 computer which is based on the Intergraphic Computer designed by a research team of the University of New South Wales. The company has sole world rights to manufacture the computer in Australia and market it commercially.

*Mr Derek Barlow (left), sales manager of Hewlett-Packard Australia Pty. Ltd., on a recent visit to the Hewlett-Packard plant at South Queensferry, Scotland, discusses a new microwave link analyser with Mr Colin Grossart, a quality assurance engineer.*

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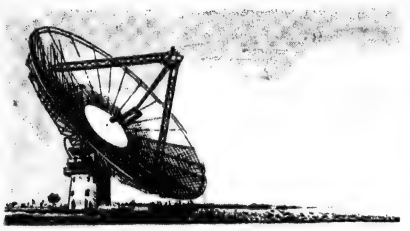


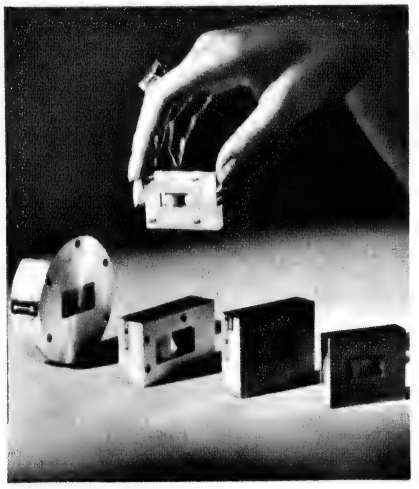
## Probing the Northern Lights

The Lockheed Electronics Co., Plainfield, New Jersey, U.S.A., in co-operation with NASA, recently launched 12 helium-filled balloons 22 miles above Alaska with 30-pound instrument packages to probe the secrets of the Aurora Borealis. Modern satellites have revealed that the Northern Lights result when high energy ionised particles leave the earth's north-south geomagnetic lines and interact with other particles in the earth's upper atmosphere. By measuring the rays they emit, Lockheed scientists hope to determine the particles' sources and the mechanism by which they are accelerated to high energy levels.

## Electronic toll system

An advanced electronic toll registration system, incorporating television traffic monitors and radio controlled emergency service facilities, is being installed on the Auckland Harbour Bridge under a $A1.1-million contract awarded to Plessey (N.Z.) Ltd. The solid state electronic system will replace the existing electro-mechanical equipment originally supplied by the same company. The control room will include services to operate the bridge gantries for lane traffic switching on the bridge and its approaches.

## Slimline isolators



*These Slimline microwave isolators, recently introduced by The Marconi Company, Chelmsford, Essex, England, feature considerable reductions in size and weight. Compared with earlier designs, the new components take up little more than the width of a pencil in a waveguide run. They are said to be particularly suitable for airborne radar applications. In operation they act as one-way devices to microwave signals, preventing the feedback of reflected waves.*

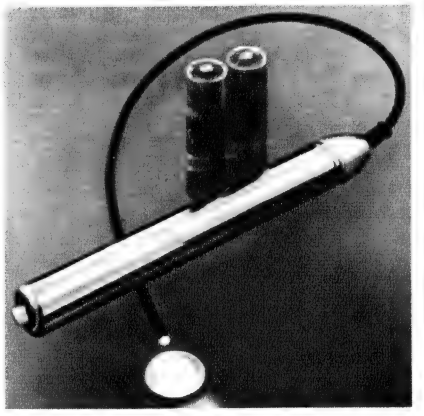
## Optical pumping patent

A patent, issued in 1968 to the Westinghouse Electric Corporation by the U.S. Patents Office, affects all equipment concerned with any type of optically pumped laser. The patent recognises that optical pumping, basic to lasers, was invented by Dr Irwin Wieder at the Westinghouse Research Laboratories.

## Honour to PAL inventor

The Saarland Government recently conferred on Dr Walter Bruch, the inventor of the PAL colour television system, the title of Professor in recognition of his outstanding scientific merits. The honour was conferred on him at the annual conference of the German Television Society. Professor Bruch, who is 60, is head of television basic development of AEG-Telefunken.

## Flexible light



*The shock-proof "Speck-O-Lite" emits a penlight beam of light and transmits it along a 12in flexible light guide, using fibre optics. It puts a beam of "cold" light directly on a subject, delivering light round corners and through holes as small as 1/8in in diameter. It is ideal for production inspection, repairs and for lighting meters, dials, etc. Speck-O-Lite is available either as a complete unit or as a bulb assembly/adapter with light guide, from Singer Products Co. Inc., 95 Broad Street, New York, N.Y., 10004.*

## Sound-in-vision

An experimental sound-in-vision system has been developed by the B.B.C. Research Department in the U.K. for the single-line distribution of 625-line television signals. A period of 3.8uS within each 4.7uS line synchronising interval, symmetrical with respect to the leading and trailing edges of the line synch pulse, is occupied by a PCM sound signal. The sound signal is sampled at twice line frequency, a bandwidth of 14KHz being allowed. The two samples during each line period are converted to PCM signals, delayed and compressed, and inserted into the video waveform during the next line synch interval.

It is necessary to extend alternate equalising pulses from 2.35 to 4.7uS in order to provide room for the sound pulses during the full blanking interval. In the receiver, the sound pulses are extracted and reconverted to normal audio signals, and the video waveform is restored to standard form. ■

# A Power Supply and Probes for the Solid State V-O Meter

A "follow-on" article to that of December, describing a number of useful accessories for the new instrument. Included are a mains power supply, an active AF probe unit and probes for RF and high voltage measurements.

by Jamieson Rowe

Complete independence from the AC power mains is one of the more obvious advantages offered by the Solid State Volt-Ohm Meter (SSVM) described in our December 1968 issue. In contrast with the conventional VTVM, and by means of its inbuilt battery supply and isolated solid state circuitry, the instrument is capable of making measurements not only "in the field" remote from the power mains, but also in situations whehe the circuitry involved in the measurements is "floating" with respect to earth.

Although this facility will prove extremely useful on occasion, there will doubtless be many situations in which the instrument will spend a major part of its working life on the service or development lab. bench, with the AC mains conveniently at hand. In the interests of battery economy it is therefore desirable that provision be made for the instrument to be powered from the mains when required. In fact a polarised socket was provided at the rear of the instrument for this purpose.

POWER SUPPLY: The small power supply whose circuit is shown in figure 1 will perform the required function while leaving substantially unaltered the ability of the instrument to make measurements in "floating" circuitry. Needless to say there will be a definite limit to the voltage at which the instrument can safely "float" relative to the mains supply and mains earth system, as determined by the power transformer primary-secondary and secondary-core insulation; however, within the range below this restriction the performance of the instrument should be virtually identical to that when powered by the internal battery.

The supply consists of a simple bridge rectifier circuit, floating with respect to earth, and employing four silicon diodes together with a miniature 12.6V/150mA stepdown transformer. A 500uF/25VW electrolytic capacitor provides smoothing. Output from the supply is very close to 19V when unloaded, falling to approximately 18.5V when the SSVM is connected. Ripple output is very low.

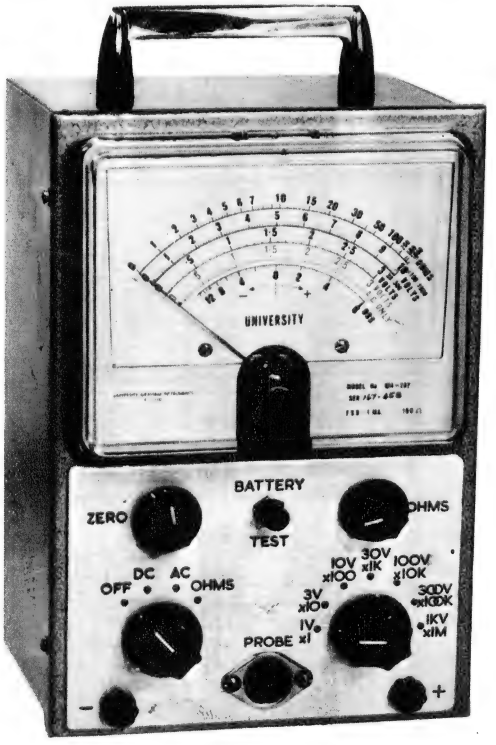
As may be seen from the photographs, the prototype supply which we built up for the original SSVM was constructed in a small aluminium utility case. Measuring 5in x 2¼in x 2¼in, the case provides ample capacity for the few components required.

The mains cord for the supply is clamped at one end of the case immediately upon entry via a grommetted hole. The active and neutral conductors are then terminated and connected to the transformer primary leads via a 2-way section of "B-B" connector strip, bolted to the bottom of the case. The earth conductor is soldered to a lug clamped under the adjacent transformer mounting bolt, ensuring that the supply case itself is earthed for safety.

All of the minor components associated with the secondary circuit are supported on a miniature 8-lug tagstrip at the end of the case opposite to the mains cord entry. The DC output cable enters the case at the same end, again via a grommetted hole, and is knotted upon entry to prevent strain on the tagstrip lugs.

AMPLIFIER PROBE: The AC input sensitivity of the basic SSVM is limited to 3V FSD, largely due to the linearity problem associated with the silicon rectifier diode used. While this sensitivity will probably be adequate for many routine AC measurements, there will be applications in which it will not be sufficient. Perhaps a majority of such applications will involve low-level audio signals, so that a very useful accessory for the SSVM is an active AF probe system providing a measure of signal preamplification.

Figure 2 shows the circuit of an active AF probe unit which may be used to extend the effective AC input sensitivity of the SSVM by up to 30dB—i.e., to a maximum sensitivity of 100mV FSD. The gain is actually




*At left is the SSVM itself, described in the December 1968 issue. It is virtually a solid-state equivalent to the usual VTVM. Below is the mains power unit as described in this article.*

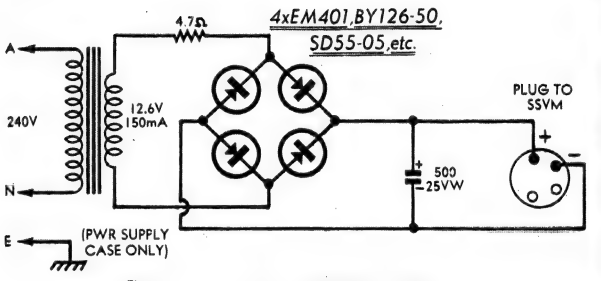
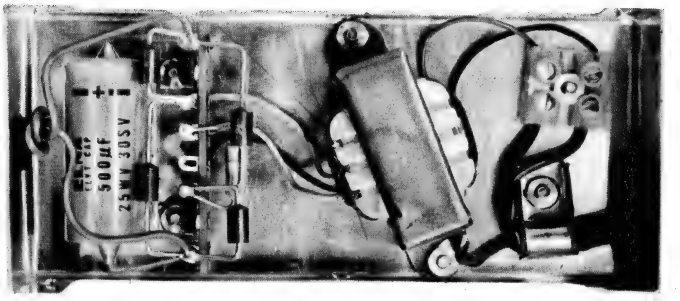



Figure 1 MAINS POWER SUPPLY



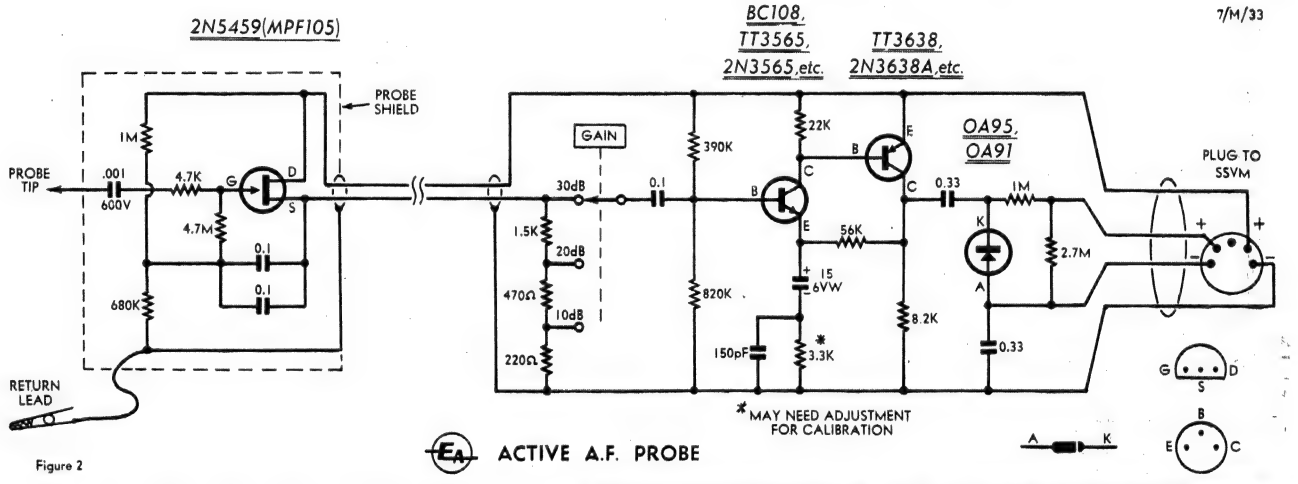



Figure 2

*At top are the circuit and interior view of the SSVM mains power supply. Above is the circuit of the AF preamp-probe, while at right is a view of the preamp probe and control box when completed.*


switched in 10dB steps, so that two intermediate gain positions are available. The SSVM is thus also provided with the 300mV and 1V FSD ranges necessary to give it an effective unbroken AC measurement range of 100mV — 1000V.

Bandwidth of the probe unit is from 20Hz to somewhat more than 400KHz (+0, −5%). Input impedance is sufficiently high to present negligible loading to almost any circuit under test, consisting effectively of 20 megohms shunted by approximately 7pF. Current drain from the SSVM is less than 5 milliamps.

The unit consists of a probe-mounted impedance transformer stage, coupled to a "control box" section which includes a switched attenuator, a two-transistor feedback voltage amplifier and a peak detector. The control box connects in turn to the probe input socket on the front panel of the SSVM.

The probe-mounted impedance transformer section of the unit consists of a JFET source-follower stage which employs an N-channel Motorola device, type 2N5459 or MPF105, available from Cannon Electric (Aust.) Pty. Ltd., either direct or on order via trade suppliers. The source-follower configuration provides the required high input impedance while also providing the low output impedance necessary for minimal cable losses at high frequencies.

The load of the source follower is not in the probe section of the unit, but consists of the switched attenuator in the control box. By this means the component count in the necessarily confined probe casing is reduced, without sacrifice to the performance of the unit.

The two-transistor feedback amplifier which follows the switched attenuator is a conventional direct-coupled complementary circuit employing a BC108 or similar NPN input device and a TT3638 or similar PNP output device (both silicon). It provides a fixed gain of approximately 17 times, which may be adjusted, to perform overall calibration of the probe unit by alteration of the nominal 3.3K lower feedback resistor.

The final section of the unit consists of a peak rectifier circuit employing a germanium diode type OA95, OA91 or similar. It may be noted that the input capacitance of the half-wave circuit is split into two separate capacitors, one at the "active" input and the other at the "earthy" input; this is necessary in order that the rectifier can connect into the SSVM without disturbing the "floating" input circuitry.

In passing it should perhaps be noted that the probe unit of figure 2 is basically quite suitable for use as a preamp. probe with oscilloscopes and other instruments. All that is necessary

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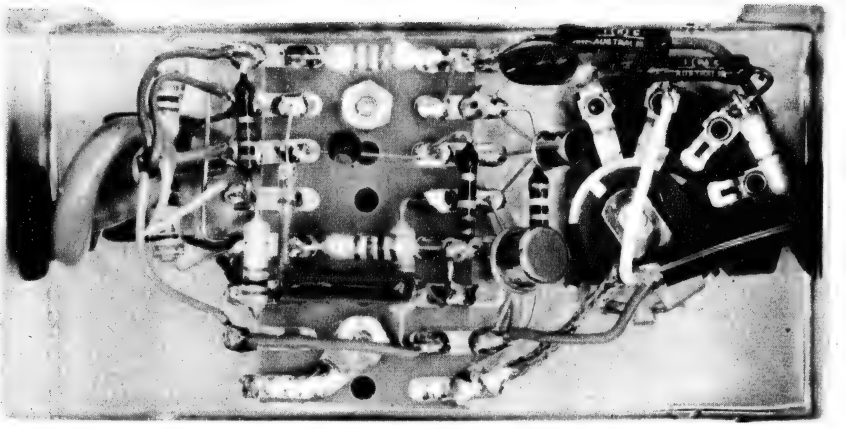
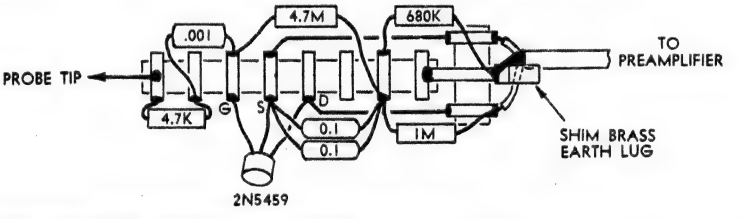
to adapt it for such use it to omit the peak rectifier circuit, change the value of the lower feedback resistor, and provide a suitable source of approximately 12-18V DC. Further details of this application of the probe are given in a short note following this article.

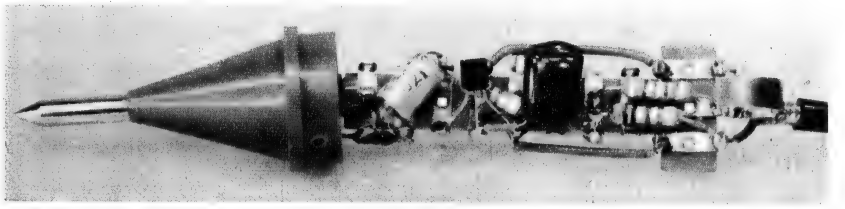
The construction of the active AF probe should be fairly apparent from the photographs. The impedance transformer components are mounted on a slightly modified 8-lug miniature tagstrip attached to the rear of the tip of a "Jabel" probe case, with a second 3-lug tagstrip used to anchor the cable leading to the control box. A small spring strip bent from sheet brass and soldered to the "earthy" output lug ensures that the probe casing is "earthed" upon assembly, so that it acts as an effective shield. Note that, to conserve space inside the probe, the 0.2uF boot-strapping capacitor is made up from two parallel-connected 0.1uF LV plastic components.

Inside the control box section most of the components are supported on an 8-lug section of miniature resistor panel. The only exceptions are the switched attenuator resistors, which are mounted directly on the lugs of the 3-position rotary switch. The position of the components should again be fairly clear from the photographs; in any case the wiring is not critical and moderate deviations from the prototype would be quite in order. The case used for the control box is a small utility box similar to that used for the mains power supply, but slightly smaller: 4in x 2¼in x 1 5/8in.

Note that for highest accuracy the resistors of the switched attenuator should ideally be precision high-stability types. However, as with the attenuator of the SSVM itself, other resistor types may be used with some degradation of accuracy.





*Shown at top is a view of the interior of the preamp probe control box, the lead from the probe entering at right. Below this are a wiring diagram and photograph of the interior of the probe itself.*

RF DIODE PROBE: The usefulness of the basic SSVM at frequencies above the 400KHz range of the probe just described tends to be limited by two factors, both of which also apply in the case of a conventional VTVM. The first of these is that, with conventional test leads connected to the instrument, the capacitive loading presented to the circuit under test is rather high, and tends to disturb normal circuit operation. The second factor is that the AC input sensitivity of 3V FSD is often insufficient to permit useful measurements.

The first of these factors can be overcome with the SSVM in exactly the same manner adopted with the VTVM, by the use of a diode RF probe. This reduces to a bare minimum the wiring and components connected intimately to the test circuit at high frequencies, by placing the AC-DC conversion peak rectifier right at the test point. The DC output of the rectifier is then taken back to the meter via decoupled wiring which is "cold" relative to the high frequency signals being measured.

With the SSVM the use of a diode RF probe can also provide a significant improvement in the effective input sensitivity, and this may be regarded as a further advantage of the instrument over a conventional VTVM. The advantage arises because the AC sensitivity of the SSVM was limited to 3V FSD, not by the intrinsic sensitivity of the meter amplifier, it may be remembered, but by the linearity problem associated with the high-PIV silicon diode required for the peak rectifier.

Whereas it is necessary that the diode used in the peak rectifier circuit of the SSVM itself be capable of withstanding many hundreds of volts, this requirement need not apply to the diode used in an RF probe intended for low-level measurements. Hence it becomes feasible to use in the probe a germanium diode having a modest PIV rating of 90-100 volts, and more importantly having a forward conduction characteristic which results in a considerable improvement in small-signal linearity.

As a result of the foregoing it has been found possible to produce a diode RF probe for the SSVM which not only reduces capacitive circuit loading to a minimum, but also extends the effective AC sensitivity of the instrument by 10dB. The circuit for the probe is shown in figure 3.

As with all direct-connected rectifier probes the input impedance of this probe varies considerably over the signal cycle. The minimum impedance presented occurs at the negative signal peaks, when the diode conducts and a pulse of current flows through the input capacitor; input impedance during the current pulses may be as low as a few kilohms. For the remainder of the signal cycle almost the only current which flows through the input capacitor is that due to its relatively slow discharge into the DC load resistance; here the input impedance may be more than two megohms.

Very approximately, the average input impedance of the probe will be something like 100K shunted by 3pF. The lower frequency limit is approximately 20KHz (—5%), while the upper frequency limit is determined mainly by the components and layout employed. Typically the probe will be fairly accurate up to approximately 70MHz.

With the probe connected to the SSVM and the range switch turned to the 3V (AC) range, the combination will have an effective sensitivity of 1V RMS—read on the appropriate 0-10 scale of the meter, it should be noted. The other AC ranges will similarly be increased in sensitivity by 10dB, although the probe diode PIV rating will place a limit on the useful range of 90V peak-to-peak (approximately 30V RMS for sinewave signals).

It may be realised that this represents a significant increase in RF sensitivity relative to the conventional VTVM. Thus although the effective 10dB gain provided by the probe will involve a certain amount of "mental gymnastics" on the part of the operator (transposing from one meter scale to the other, mentally dropping one range, etc., it should be found quite worthwhile.

Of course if the increased effective sensitivity is not required, the series multiplier resistor in the probe may simply be increased to give additional voltage division of the rectifier DC output, a value of approximately 9.2M

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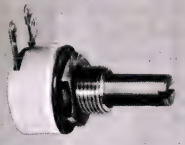

Type Q

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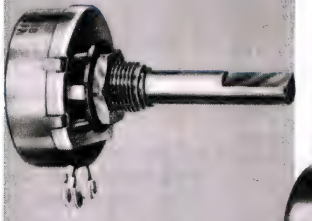
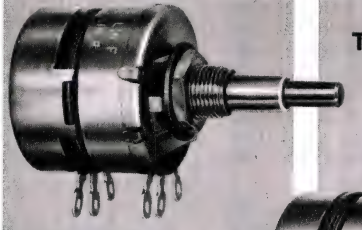
Type L Mark 2

Type M

## standard and dual



Type E



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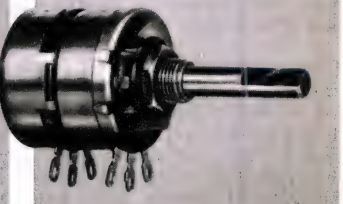

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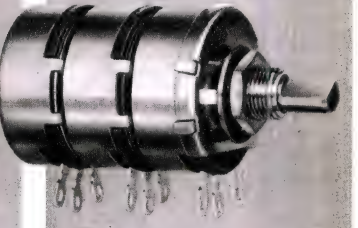

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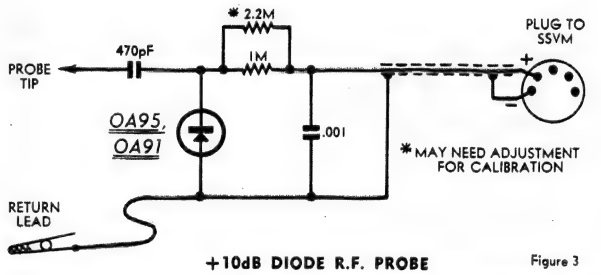
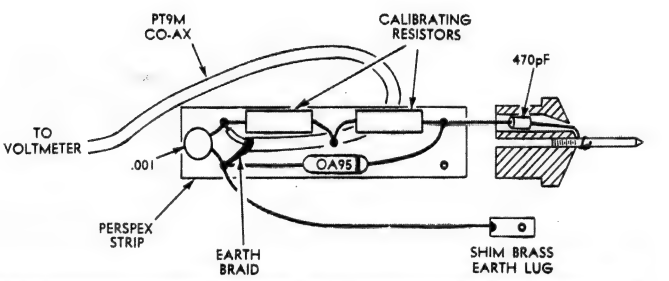
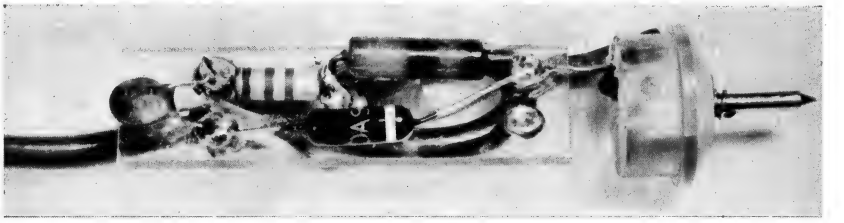



+10dB DIODE R.F. PROBE

Figure 3




*Above, above right and at right are shown the circuit, wiring diagram and interior photograph, respectively, for the diode RF probe. The version shown is that with "OdB" effective gain.*



(8.2M in series with 1M) will give an effective probe gain of unity (OdB), restoring the meter ranges to their marked sensitivities and obviating possible mental strain. Naturally the 30V RMS input voltage limitation will still apply.

A possible compromise between the foregoing alternatives would be to fit the probe with a slide switch, enabling the sensitivity to be altered at will. Another approach would simply be to construct two separate probes, one giving the effective 10dB gain and the other an effective gain of unity.

The construction of the diode RF probe should be fairly evident from the photographs and the diagram. The probe shown is actually a "OdB" version with 8.2M and 1M series multiplier resistors; the "+10dB" version is identical except that the two series resistors are replaced by the appropriate parallel combination. In each case the 470pF input capacitor is a compact ceramic unit with leads cut to a bare minimum, and mounted as closely as possible to the probe tip to minimise stray capacitance.

The 2.2M resistor of the "+10dB" version and the 1M resistor of the "OdB" version of the probe may need to be altered in value in order to calibrate the probe-SSVM combination against an external reference. However if calibration facilities are not available, the values shown will probably be found close enough for most purposes.

EHT PROBE: A fourth useful accessory for the SSVM is a high voltage divider probe, to permit the safe and convenient measurement of voltages up to 30 kilovolts. With such a probe it becomes possible to use the SSVM to measure the EHT voltage of television receivers, oscilloscopes and similar equipment.

The circuit of a high voltage probe suitable for the SSVM is shown in figure 4. It provides a 1000:1 voltage division, so that the 1V DC range of the SSVM will effectively read 0-1KV, the 3V range 0-3KV, the 10V range 0-10KV and the 30V range 0-30KV. The other ranges would in theory correspond to appropriately higher voltages; however it should be noted that in most cases the high-voltage precision resistor used in the probe will have a maximum voltage rating of 30KV, limiting the safe working range to below this figure.

Note that this figure is a peak rating, so that for AC measurements the

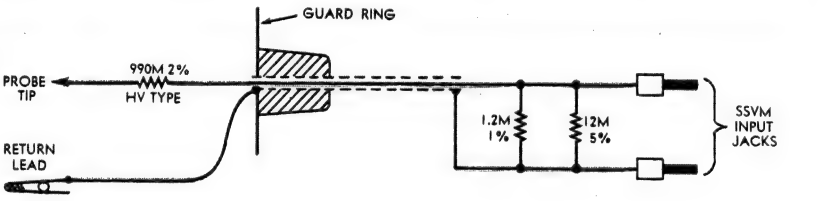
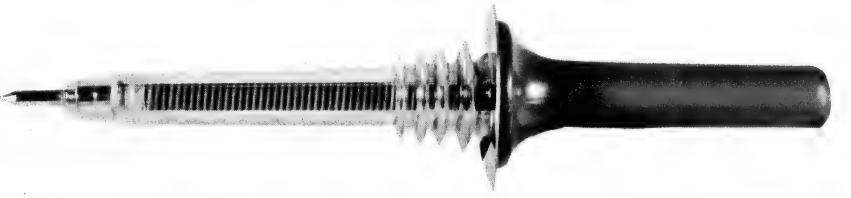
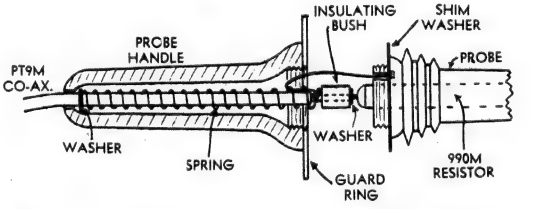



Figure 4

HIGH VOLTAGE 1000:1 DIVIDER PROBE



*Above are the circuit and exterior view of the high voltage divider probe, which uses a special high voltage resistor. At right are the constructional details.*




maximum safe working range will be limited to approximately 20KV RMS for sinusoidal signals. Non-sinusoidal signals will generally have an even greater peak/RMS ratio, giving an even lower maximum RMS figure; the exceptions are square or near-square waves, which have an RMS value approaching their peak value.

Effective loading resistance of the probe is fixed at 991M, which corresponds to a measurement current of approximately 31 microamps at the maximum voltage of 30KV.

The 990M 2 per cent high voltage precision resistor used in the probe (IRC type MVM, or similar) is identical to that used in 100:1 divider probes previously described for our VTVM projects. We have used it here mainly because although it is a special type, it is also readily available. In fact, because of the particular input resistance of the SSVM, it is not possible to use the resistor for the 100:1 division originally envisaged; however by shunting the SSVM input resistance with 1.2M and 12M resistors as shown, the resistor provides an accurate 1000:1 division. As the current through the resistor and the voltage impressed upon it are within approximately 1 per cent of the previous values, the alteration in division ratio involves no sacrifice in safety or reliability.

Note that the high-voltage probe connects to the banana-jack input connectors of the SSVM rather than to the probe socket. This allows the probe to be used to measure voltages of either polarity, by permitting the connection plugs to be inserted either way around as appropriate with the "return" side of the probe connected to the earthed chassis of the equipment under test. When measuring high voltages of either polarity, and particularly when measuring high voltage AC, it is advisable to ensure that the SSVM case (isolated from the internal circuitry) is also connected to earth.

In the interests of safety and reliability the high voltage resistor should be mounted in a special probe casing similar to that shown in the photograph (which is made by University Graham Instruments). The casing includes a spring-loaded contact system for the resistor, and a guard ring which connects to the return lead. As before, the construction of the probe should be fairly obvious from the diagram. ■

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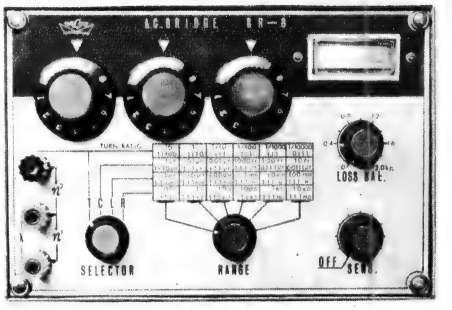


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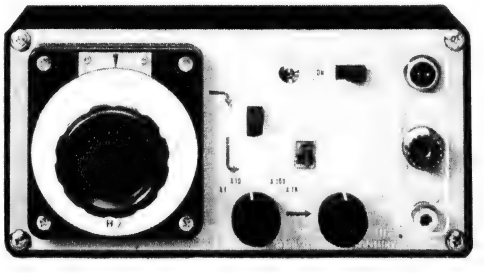

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# High Impedance Probe, Preamp for CROs & VTVMs

The active AF probe unit described in the preceding article may be adapted quite easily for use as a self-contained high input impedance probe/preamp unit for oscilloscopes, VTVMs and other equipment. Described in this note are the simple modifications required for such applications.

by Jamieson Rowe

When modified according to the accompanying diagram, the unit forms a self-contained high-impedance instrument probe and preamp which is very suitable for use with oscilloscopes, VTVMs, and other instruments. Frequency response within -3dB points is approximately 20Hz — 500KHz, with an input impedance of approximately 20 megohms shunted by 7pF and an output impedance of less than 1K. Noise output is less than 5mV RMS, with an output voltage capability of more than 9V P-P. The probe circuitry is capable of withstanding input overloads up to approximately 600V DC and 50V RMS without damage, ensuring a high order of reliability.

As may be seen, the modifications are few. The peak rectifier circuit is omitted from the output, while the lower feedback resistor of the feedback amplifier becomes a parallel 1.5K/10K combination. The 10K element is used as a vernier gain adjustment for calibration. To compensate for the reduction in feedback resistor value, the HF peaking capacitor is increased from 150pF to 390pF. All other component values in the basic circuit are unchanged.

The circuit modifications are all in the "control box" section of the unit, so that the wiring and construction of the probe section is identical to that shown in the preceding article. Within the control box the changes are slight and the wiring and component layout may be substantially as described. The omission of the peak rectifier components will provide additional space and spare lugs on the resistor panel, but these may be required for whatever power supply is employed.

Power requirements for the unit are 12-18V at less than 5mA, with the output voltage swing capability directly proportional to the supply voltage. If the unit is to be used in the field or intermittently, the simplest source of supply would be an 18V battery, as shown. At the small current drain involved a suitable combination would be two miniature "216" batteries connected in series; it would probably be possible to fit a pair of these batteries and the required on-off switch in the control box case shown in the preceding article.

If continuous use is envisaged and the mains supply is available, a small mains power supply would be appropriate. This could take the form of a low-current voltage double supply using a miniature 12.6V transformer and two silicon diodes type BA100 or similar, as shown in figure 2. If the control box section of the unit were constructed in a box similar to that used for the SSVM power unit described in the preceding article, there would be room for the power supply as well.

A further possibility would be to derive the power for the circuit from the equipment with which it is to be used, as with the original probe unit. If a source of DC is available, this may involve nothing more than a voltage divider with decoupling, or perhaps a zener diode divider if the available DC voltage varies over a wide range. If only AC is available, it would be feasible to employ the rectifier-filter section of the supply shown in figure 2, connecting it to the equipment heater line.

For further information regarding the provision of power supplies for this and similar circuits, readers are referred to the author's article in the October 1968 issue of the magazine, entitled "Power Supplies for Transistors in Valve Equipment".

In closing it should perhaps be noted again that the 2N5459 JFET device (which supersedes the MPF105) is a Motorola product, available either direct or on order via trade suppliers from Cannon Electric (Aust.) Pty. Ltd., of 58 Cluden Street, East Brighton, Vic. 3187., P.O. Box 25, Mascot, N.S.W., 2020, or Commonwealth Aerodrome, Parafield, S.A., 5106. ■

*Below is shown the complete circuit of the modified preamp probe, which provides up to 30dB of gain over 500KHz bandwidth. At right is a suitable mains power supply for the unit.*

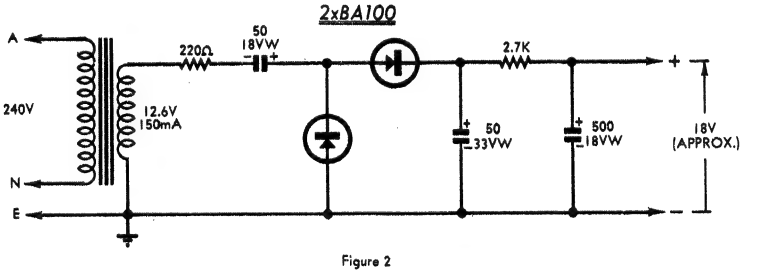


Figure 2

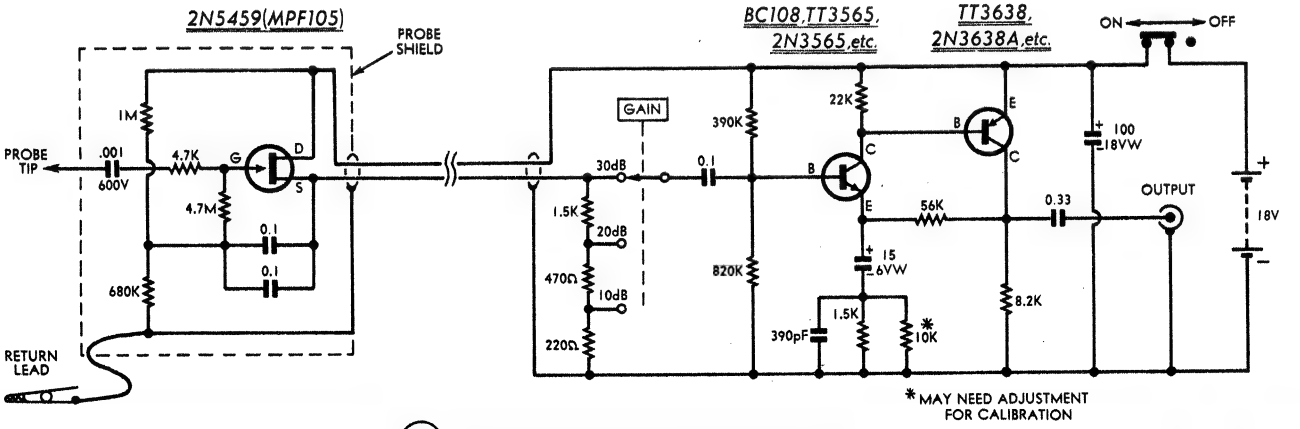


Figure 1

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# INSTALLING A CAR RADIO

It is some time since we discussed the ramifications of installing a car radio. The last article was in July 1959, as a follow-up to the description of our own 1959 Karset. Since then there has been another Karset (June 1961) and a lot of changes in car styles, aerials, accessories, etc. It is the purpose of this article to deal with the installation of car radios in general, whether one of our own design, or the commercial variety; whether new or second hand.

In fact, there has been quite an upsurge in the popularity of second-hand sets, apparently due to the swing to solid state versions by those who must have the latest at any cost. The result is reasonably plentiful supply of valve receivers which, while not "modern" by some standards, are still capable of putting up a first class performance by any standards. For younger people, on a limited budget, such a proposition is attractive, particularly if further cost can be saved by doing one's own installation.

In most cases, installation is merely a matter of routine, involving the fitting of major receiver components and two or three standard suppression components. It may be summarised as follows:

1. Mount the receiver proper.
2. Mount the speaker.
3. Fit the aerial.
4. Eliminate engine interference.

It will be unrealistic not to acknowledge that there are cases of engine and accessory interference which are very difficult to deal with effectively. Much of the information is aimed at helping readers who are unlucky enough to strike a particularly stubborn case.

Most modern cars make some provision for mounting a radio in a position such that it does not interfere with the normal space inside the passenger compartment. Often there is a panel in the instrument or dashboard which can be removed and the set substituted.

Another possibility is to take this panel and modify it to provide a suitable dial cutout and the control shaft holes to suit the set. Before doing so, it would be very wise to make sure that your local distributor holds stocks of replacement panels. In fact it may be a good idea to buy one and keep it on hand in case you decide to sell the car at a later date without the radio. Panels for the particular model may then be out of stock.

It is desirable to mount the receiver where it can be reached easily by both the driver and the passenger, which puts the best position somewhere near the centre. Failing that, the next best position would be on the driver's side of the car. Compartments and spaces which can be usefully employed otherwise should be avoided if at all possible, e.g., glove box and parcel tray.

In choosing the position, bear in mind also that the set should be reasonably easy to remove for service. It can be extremely annoying, when the set has to be serviced, to find that one has to go through a laborious process in order to remove it, followed by an equally laborious process to replace it. Even worse, a set sometimes has to be removed a second time in order to complete some minor adjustment, the need for which was not apparent on the bench.

Good electrical contact between the case of the receiver and the car body is essential, because the primary power circuit is completed by this means. A good bond between case and chassis also assists in reducing ignition interference.

You may need to manufacture special straps or brackets. A fairly typical case is shown in the diagram, where a strap underneath the front of the set is used to hold it to the dash and a second strap, secured to the back of the set, placed to hold it to the bulkhead. The dimensions of the straps, particularly the latter, will depend on how far the bulkhead is from the back of the set. Not less than 16-gauge by 1in mild steed is normally required. Suitable straps, drilled with multiple holes, are normally available from car radio accessory houses.

Many cars have provision for mounting the speaker in the dashboard and it is worth checking carefully with your car to see what space is available.

Smaller speakers may be necessary in some cars, but we strongly recommend that you try to use at least an 8in round speaker. Steel cases with strong metal mesh protecting the cone are available and it is usually possible to mount one on the bulkhead above either the passenger's feet or the centre of the car.

It is not always fully appreciated that a speaker in a car has to overcome a substantial ambient noise level when a car is in motion. For this reason it should be able to make the best possible use of the available audio power, and should be the largest and most efficient that can be provided.

In this regard, the car radio division of AWA have issued the following note.

"Due to the environment in which they have to operate, loudspeakers used in car radio installations are subject to rigours not usually encountered by loudspeakers installed in apparatus used in the home.

"For this reason, AWA designs and makes specific loudspeakers especially for car radio work and we therefore advise that, whenever a car radio loudspeaker has to be replaced, care is taken to ensure that the replacement is a car radio type."

Ignition interference can reach the input of the receiver through the speaker socket. It is necessary to carefully shield the speaker voice coil lead and make sure that the speaker frame is connected to the earthy side of the shielded cable as well as one side of the voice coil.

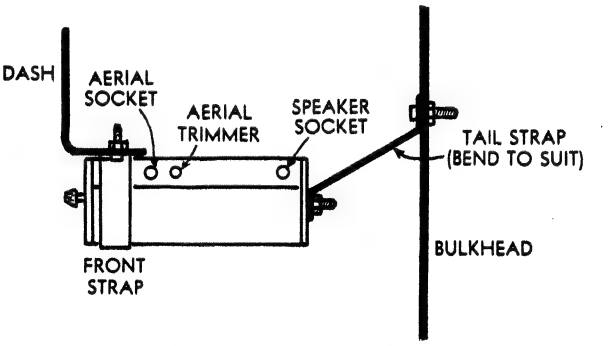
The next matter to consider is the type of aerial and its mounting position on the car.

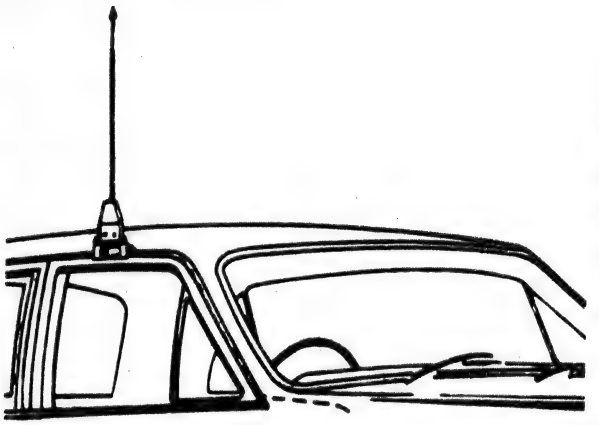
Nowadays, 99 per cent of car radio installations make use of a single whip aerial and this is what we recommend.

There is a wide range of aerials available on the market at present. They range all the way from a simple "gutter grip" arrangement to electric motor driven types controlled from the dashboard. What you select will depend to a large extent on what you can afford.

In the early days of car radios, choice of an aerial was relatively simple; it was dictated mainly by the type of car and varied only in regard to the mounting position and the fittings which this dictated. The aerial proper was basically the same; a simple telescopic whip which one adjusted manually to the height required. The main restriction was that one usually

*No one mounting arrangement will serve for all vehicles, but the one shown is, with minor variations, a very popular one. Straps and other fittings are available commercially.*





*The "gutter grip" aerial is very popular where it is undesirable to drill the car body. It is easily folded down to minimise damage from trees or vandals. (By courtesy Ferris Bros. Pty. Ltd.)*

had to get out of the car to adjust the height, extending it to maximum for country driving or retracting it for city driving to minimise damage when entering the garage or from shrubs on the side of the driveway. However, such adjustments were relatively infrequent, and constituted little hardship.

Then came the hoodlum element whose moronic intellect derives a strange pleasure from ripping aerials from parked cars or, by way of variation, tying them in a knot.

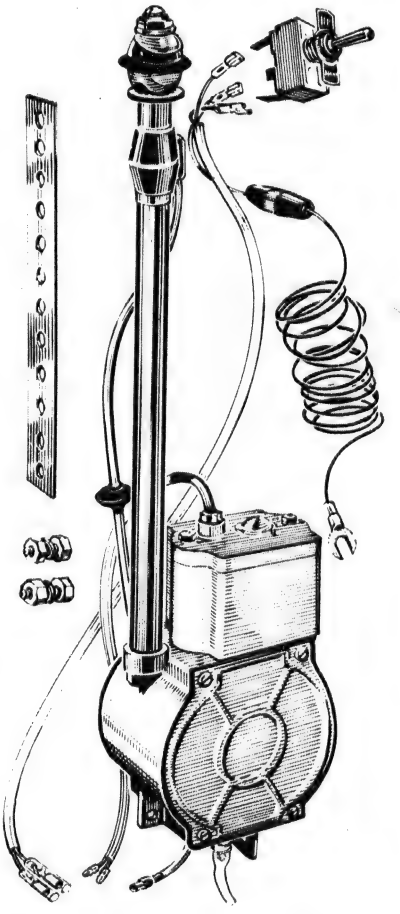
The counter to this was the lock-down aerial. This type can be fully retracted, almost flush with the body-work, so that there is virtually nothing for the morons to manhandle. It locks in this position and can only be released by means of a key. The idea is a good one—provided one scrupulously adheres to the ritual of locking the aerial down whenever the car is parked and, by implication, extending it again each time one returns to the car. In practice few people seem able to discipline themselves sufficiently and the aerial either remains locked down, and therefore of little value, or extended, and therefore just as vulnerable as any other type.

The counter to this problem is the fully retractable motor driven type. Being completely controlled from the dashboard, it need only be extended when actually required, and by whatever amount required. As a result, it receives less abuse from all sources, plus the fact that it can easily be retracted whenever a hazardous situation is anticipated as when entering a driveway or garage, or approaching low, overhanging branches. In short, it is the complete answer—if you can afford it. Prices range from $20 to $40 and the main difference appears to be that the simpler, less expensive mechanisms will probably have a shorter life before servicing is required.

In this regard it should be emphasised that all power operated aerials on the Australian market at the present time are imported. Before deciding on a model, make sure that spare parts and servicing facilities are available.

Having decided on the broad type of aerial preferred, there comes the question of mounting location; front or rear, driver's side or passenger side. Either front position has the advantage that the length of cable from aerial to set is kept to a minimum. Since the cable introduces losses, this can be important. The front position also has the advantage that, in some cases, the aerial may be located within reach of the driver or passenger, so that it may be adjusted without stopping the car. Fairly obviously, users of power driven models have more latitude in this regard.

Driver-side mounting has the advantage that, when parked, the aerial is out of the immediate reach of hoodlums on the footpath, who might therefore be less encouraged to damage it. Also, if it can be within reach of the front seat occupants, the driver is the logical one to favour. Against this is the fact that it is sometimes quite difficult to find a front mounting driver's side position which does not come within the driver's normal field of view.



*The ultimate in car aerials is the power operated variety, controlled from the dashboard. Extended only when necessary, it suffers minimum wear and tear. (By courtesy A. W. Barrs Pty. Ltd.)*

The longer the aerial the greater the pickup but also the greater the likelihood of damage and therefore a compromise must be reached. Our own experience has been that radio aerials on cars are so liable to damage that the aerial should be, if anything, on the short side. We would choose whip about 18in or 24in long in its collapsed state and with three sections allowing it to extend to 4ft or 5ft.

Fully collapsed, this will provide more than adequate pickup of stations within a 20-mile radius under most conditions while the aerial can be extended to its full height if you feel like some entertainment on country drives.

Choose the exact mounting position for the aerial with great care because the cost of repairing the damage of an incorrectly positioned hole plus matching the lacquer can be very discouraging. It should not be in any difficult contours in the car body otherwise it may be hard to obtain perfect weather sealing. At the same time, the lower end of the aerial should be at a point which is easily accessible, preferably inside the passenger compartment.

Individual aerials vary in their mounting procedures. Make sure you know how the particular aerial mounts when you take delivery.

Many car radio firms are quite happy to mount the aerial free or for a very nominal fee. They usually know exactly where to put the hole and have all the tools necssary to make it the work of a moment so that you may not be justified attempting the job yourself.

Screened cable, suitably terminated at either end and about 6ft long, is usually supplied with the aerial. If you should have to make up this cable for yourself be sure that you buy the semi air-spaced low capacity cable specially designed for car receivers. A typical sample would have a capacity of only 10pF per foot instead of 20pF per foot for ordinary co-axial cable. In other words, with the low capacity cable, the cable length can be double for the same effect on the signal. The cable should be as short as possible consistent with stowing it neatly and ease of plugging in the connectors.

It is most important, in the interest of suppressing ignition noise, that the shielding on the aerial cable be effectively "earthed" at both ends; to the body of the car at the base of the aerial and to the chassis of the set at the other end. This usually means that the small area of metal on the underside of the body, against which the securing nuts will bear, should be scraped clean of paint before assembly. A circular wire brush, as found in "de-coking" kits, driven by a power drill is a popular tool for the job.

Another type of aerial which has gained popularity in recent years is the "gutter grip" type. This is a simple type designed to clamp on the roof gutter and is most useful where it is undesirable to drill the body of the car. It is useful for temporary installations, and is much favoured by drivers who make a business of driving cars to country or interstate centres on behalf of purchasers. Again, it is favoured by drivers who use company cars, which the com-

pany will not permit to be drilled. In any case, installation is a good deal easier than with the more conventional types.

A typical type is a two-section telescopic unit, available in two lengths, "standard" or "fringe." The standard length is 33in fully extended and about 17in collapsed. The larger one is 44in fully extended and about 23in collapsed. Although these lengths are substantially less than the lengths of other aerial types, this is largely offset by the higher elevation and, according to the makers, there is little to choose between these and other types in regard to signal interception.

The aerial is pivoted on its base and so secured that, while it will withstand any likely wind velocity from the movement of the car, it will fold down quite readily if struck by a tree branch or shrub. It may be also folded down by hand, into the gutter, whenever the car is parked, thus very effectively minimising vandalism. This action, and the reverse one to re-erect it, is so simple that it can become as automatic as locking the door.

The aerial normally mounts above the driver's window and the co-axial cable is run down the gutter into the space between the door and the frame. From here it can be taken by a number of routes, depending on the make of car, into the space behind the dashboard. The cable supplied with this kind of aerial is slim enough not to upset the normal function of the gutter. It is usually the low loss semi air-spaced variety.

Before the set can be made to work in the car, a suitable primary power take-off point must be chosen. In the maze of wires in the modern car, there is a temptation to run the lead right back to the battery or the starter motor switch, rather than find the battery lead under the instrument panel. This is not normally recommended because the lead is one extra thing to get in the way should the battery or starter motor require service at a garage.

A number of cars make provision for the radio connection with a special lug attached to the light switch and even the mounting clip for the fuse is provided. Better still, take advantage of the "accessories" terminal on the ignition switch, where one is provided. The purpose of this terminal is to prevent the radio, or any other accessory, being inadvertantly left on when the car is parked, resulting in a flat battery. Power is available from this terminal when the ignition switch is in either the "accessories" or "ignition on" position, but the key cannot be removed while it is in the "accessories" position. Whatever power pickup point is chosen it should be by-passed to chassis as a part of the ignition suppression procedure. (See page 49.)

With the speaker and aerial connected, the latter about half erected, switch the receiver on and you should be able to tune in stations normally. Try to find a weak but steady station at the high frequency end of the band or if no such station exists tune to noise between stations and adjust the aerial trimmer for maximum response.

If all is in order you should be able to hear stations at least within a radius of 50 miles in daylight hours with good signal to noise ratio. At night you would expect to hear plenty of interstate stations although the large number may make identification difficult.

As a matter of general interest, you can start the engine at this stage but it is almost certain that there will be ignition interference, at least on the more distant stations.

The next job is to work on the car itself in order to eliminate ignition, generator or any other interference which is evident with the engine running and/or the car moving.

Ignition interference can best be described as a sharp "tick tick tick . . ." each tick corresponding with a spark plug firing. Obviously the speed of the ticks varies with the speed of the engine.

Generator whine is a quite distinctive steady noise which also varies with the speed of the engine. It usually does not occur at engine idling speed when the output from the generator is not sufficient to operate the cut-out.

The cure for ignition interference, which works in most cases, is to place a resistor of about 15,000 ohms in the high tension lead between the coil and the distributor and as close to the distributor as possible. The resistor, in conjunction with the stray capacities which are in the circuit in any case, together alter the waveshape of the HT currents in such a way that the high frequency radiation is attenuated but the effectiveness of the spark, in igniting the petrol vapour, is not impaired.

Many modern ignition systems are already suppressed by reason of the ignition cable used. This uses a carbon track in place of the wire and its natural resistance replaces the suppressor resistor. Many car owners have reservations about the reliability of this type of cable and prefer to replace it with the more conventional wire type, adding suppressors as necessary.

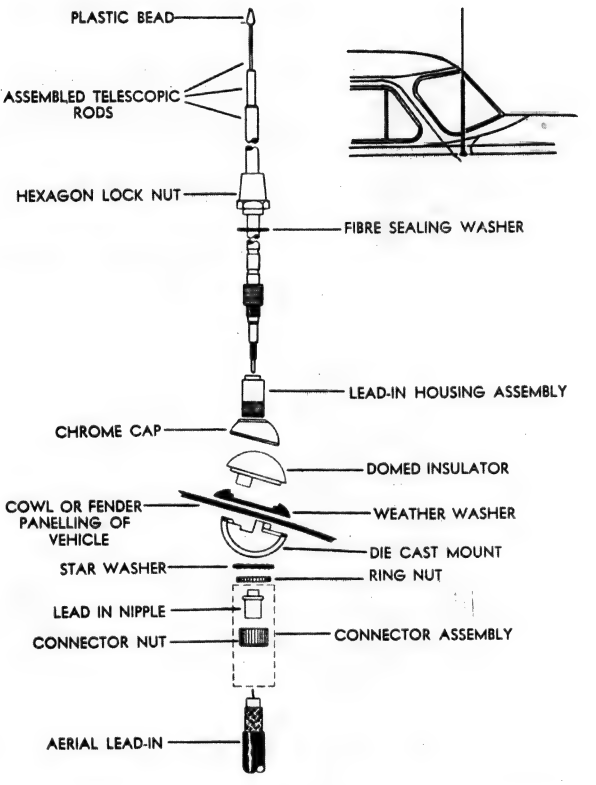
The fact that some cars have the suppressor resistor fitted as standard equipment, or use carbon track HT cable, is proof that the manufacturers do not consider that the resistance has a detrimental effect on the performance of the engine.

The significance of the resistance has been studied at length, both in the automotive and radio engineering fields. Briefly, if the carburettor and ignition systems are in order there will definitely be no deterioration in engine performance. However, if these components are in such bad condition that a weak spark is attempting to ignite incompletely vaporised fuel, then the resistance may make some difference. The solution is to put the vehicle in normal good condition.

Ordinary radio resistors are not suitable mechanically and we strongly recommend that you buy the special resistors designed for the job. For certain cars it is possible to buy a resistor which can be plugged into the distributor cap without cutting the wire.

The normal distributor suppressor has a resistance of 15,000 ohms, is about 2in long and ¼in diam. There is a round hole in each end and coaxially in each hole is a screw thread similar to that used in an ordinary wood screw.

The idea is to cut the lead between the coil and the distributor and as near the latter as possible. Insert the ends of the lead in the ends of the resistor by screwing the thread into the stranded centre conductor. It may be necessary to disconnect either the coil or the distributor end of the lead.




*The most commonly used aerial is the telescopic whip, shown here in the top cowl mounting version. It is also made in a number of other versions, such as side mounting, rear bumper mounting, lock down, etc. It is available in a variety of lengths. (Courtesy A. W. Barrs Pty. Ltd.)*

Slight contact resistance due to the simple mechanical contact between the screw and the wire can be neglected because the voltage involved is so high.

The foregoing should remove the ignition interference problems in most cases, but it is a good idea to connect a bypass capacitor between the battery side of the ignition coil primary and chassis. This will be the firewall or the engine block, depending on the mounting position of the coil.

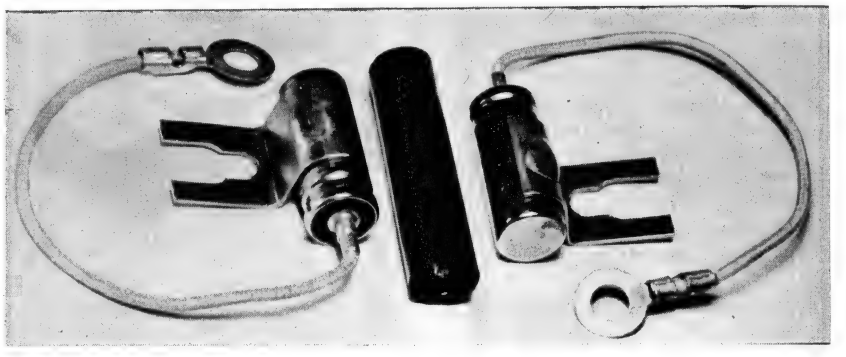
Radio bypass capacitors are not suitable mechanically, nor are they designed to withstand the high temperatures to which they are subject when mounted in the engine compartment. The correct capacitors normally have a value of 0.47uF and are encased in a metal cylinder with a metal mounting bracket. The active terminal of the capacitor normally has a few inches of wire and a termination lug.

Generator whine is usually completely and positively eliminated by a bypass capacitor, similar to the above, connected between the generator armature terminal and case. Clamp the mounting lug under a nut or screw head on the generator, not the dust band.

**It is important that the capacitor not be connected to the field terminal of the generator, otherwise the life of the voltage and current regulator contacts will be short.**

The armature terminal can usually be identified by the fact that both the lead and the terminal are thicker than for the field. Sometimes the letters "F" for field and "A" for armature are stamped on the case. Wires to the terminals may be covered with different coloured insulation. If this is so, check the colour of the lead connected to the "GEN" or "D" terminal of the voltage regulator. The terminal of the generator with a wire of that colour will be the armature.

This represents the minimum standard procedure in suppressing an installation, and is normally sufficient. More drastic measures are indicated if the trouble is still in evidence and we



*These are the standard components used to suppress engine interference in a car radio installation. The two capacitors are identical and are used on the LT pickup point and the generator respectively, while the resistor is placed in the high tension lead between the coil and distributor.*

would suggest next that you bond the top of the engine block to the bulkhead with a piece of flexible copper braid about ½in wide and as short as possible consistent with allowing the engine to move as much as necessary.

Oil films sometimes insulate the engine hood from the car body making it ineffective as a shield. Flexible copper braid again ½in wide should be used to bond it to the body. More than one such bond has been found to be necessary with some cars.

If you are unlucky and there is still some interference, make sure that the spark plug gaps are adjusted according to the car manufacturer's tolerances and also that the distributor points and the distributor rotor gap are in order. Not only will bad adjustments at these points cause intereference in the radio, but they will depreciate the performance of the car.

The next move is to tie the high tension leads away from the low tension leads and also check that there is good electrical connection between the coil case and the bulkhead or the engine block as the case may be.

Other accessories in the car such as electric petrol pumps, windscreen wipers and fuel gauges sometimes give trouble but almost always respond to a capacitor connected between the appropriate terminal and chassis. The difficulty with gauges is sometimes to determine which gauge is causing the trouble. One technique is to disconnect the gauges one by one until the offending unit is found.

An irregular ticking sound which is only evident when the car is in motion may be due to "wheel static." The grease film in the wheel bearings acts as an effective insulator until the electrostatic charge builds up to a breakdown point when the interference is heard. The cure is to ensure good electrical contact between the axle and the wheel.

Special spring loaded contacters are available or, alternatively, a graphite grease such as Castrolease "G" or similar can be used to fill the grease cups. The normal fibrous grease in the bearings need not be removed, only that which is in the cap.

A more continuous noise which can take on the character of a scream may be due to electrostatic discharges within the tyre. Some powdered graphite in the inner tube may be effective in eliminating the trouble.

There are special tricks of-the-trade in suppressing various vehicle types but it would be impossible to list them all in any one article.

However, by way of example, here is a note issued by AWA concerning a particular problem encountered in the Volkswagen 1-1500 cars.

"Problems concerning ignition noise in VW Type 1-1500 (Beetle) cars have been received and investigated.

"This noise, which is a pulse at ignition frequency audible with the volume control at minimum, is caused by the wiring in the car, from the battery to the ignition switch and back to the coil, forming a loop encircling the radio and inducing noise directly into the audio circuit.

"The cure does not lie in any modifications to the car radios but in altering the layout of the car wiring to remove this loop.

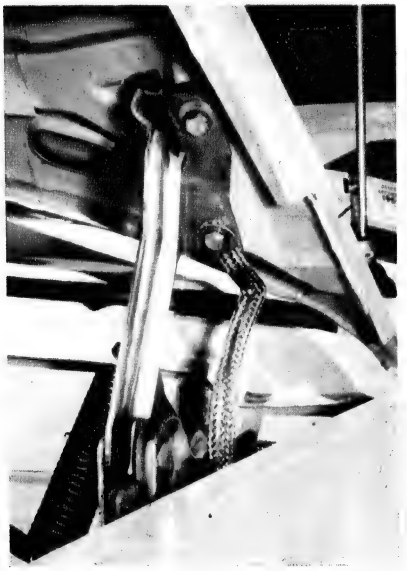
"For this purpose a kit, Part No. 69861, has been specified which com-

prises a short length of wire with connectors each end, a 3 way connector and instructions."

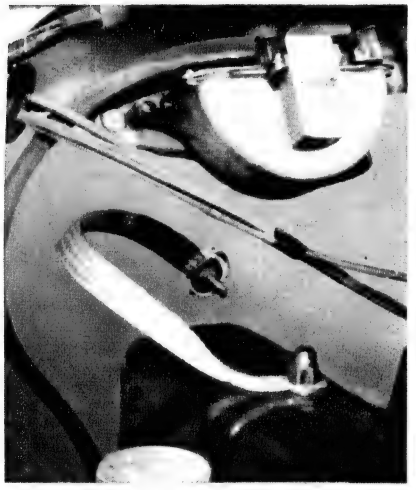
The note continues with instructions for the installation of the kit. Anyone experiencing this problem should investigate further.

Additional bonding and bypassing have often been found to be worthwhile with some of the earlier cars. The metal bulkhead can be regarded as a common point since the lead between the receiver case and bulkhead can usually be made of low impedance at broadcast band frequencies. In addition to the motor, the speedo cables, choke cable, etc., can be bonded with short flexible leads. Electrical connections passing through holes in the bulkhead may sometimes respond to bypassing with the usual metal-clad capacitors.

Voltage and current regulator chatter is not often troublesome at broadcast band frequencies but there may be rare cases. The output of the regulator goes to the generator field and, as mentioned before, it is not permissible to bypass this point because the high peak currents in the circuit would damage the contacts.



*Grease on the hinges of the engine hood can result in poor contact and the accentuation of ignition interference. A heavy copper braid will then improve matters.*



*Particularly stubborn cases of ignition interference may sometimes be relieved by connecting a heavy copper braid between the engine block and bulkhead.*

However, it is permissible to connect a .0022uF capacitor in series with a 4.7 ohm resistor from the field terminal of the voltage regulator box to chassis. If this does not effect a cure, it is likely that there is something wrong with the regulator system.

Filtering in the power input lead of most receivers is adequate for all normal purposes. However, if it is found that the RF components on the low tension line are particularly high, another LT feed point may be necessary. Alternatively, an additional RF filter in the LT lead may be desirable. You can check the point by disconnecting the aerial lead, when the receiver should be completely free of all interference.

If not, a standard LT RF choke, as used in vibrator circuits, in series with the power lead and close to the set, may be helpful. The filtering can still further be improved by bypassing the receiver side of the choke to chassis with a 0.1uF capacitor.

Another difficulty concerns cars with fibreglass bodies. These are not common, but when they do occur they represent a problem since there is no metal shield to contain the ignition impulses within the engine compartment. In such a case, we would suggest shielding all high tension leads, following the general technique used in aircraft installations. Special screened cable can be obtained from aircraft supply firms, while we understand that some plug manufacturers are able to make special screened plugs designed to connect with the screened cable and in the correct size and heat range for most vehicles. It would probably be necessary to make special metallic covers for the high tension coils so that the high tension system is completely contained. ■

## CAR RADIO INSTALLATION PROCEDURE

1. Mount receiver in selected position.
2. Mount aerial in selected position and connect shielded aerial cable to receiver. Extend aerial to about half maximum height.
3. Install speaker and connect shielded speaker lead to receiver.
4. Disconnect battery lead. Connect receiver power lead to suitable point. By-pass. Reconnect battery lead.
5. Switch receiver on. Tune to a weak steady station near the high frequency end of the band — if there is no such station, noise at about 1300KHz. Adjust aerial trimmer for maximum response and tune around the band to confirm that the receiver is working normally.
6. Close engine hood, tune between stations and start the engine. Note interference level.
7. If required, fit ignition suppressor resistor in high tension lead between coil and distributor and capacitor between coil "battery" lead and chassis. Also fit capacitor from generator brush terminal to chassis. (Do not bypass the field terminal.)
8. If basic measures of 7 fail, check plug gaps, distributor points and rotor gap. Connect flexible braid between engine block and bulkhead. Tie HT leads away from LT leads. Bond engine hood to body. Shield HT leads as a last resort in special cases.
9. Bypass petrol pump, petrol gauge, electric clock, windscreen wiper motor if required. Apply special conductive grease to wheel bearings where necessary.

# Adding a 16ft Voice to the Stromberg/Playmaster Organ

This article describes how a 16ft voice may be added to electronic organs which employ master oscillators to supply 8ft voices only to the manuals. The scheme is applicable to Stromberg/Playmaster kit organs described some years ago in these pages and to a number of other organs of broadly similar design.

By Neville Williams

First, something of the background of the project: Constructional details of the Stromberg/Playmaster electronic organ were given in the issues of this magazine (then called "Radio, Television and Hobbies") for December, 1961 to June, 1962, with supplementary references in May, 1963, June, 1964 and September, 1964.

Based on a kit marketed by Stromberg-Carlson (A'asia) Pty. Ltd. (now wound up) it was a relatively simple design by present-day standards. It had a single 49-note manual, plus a 13-note pedal clavier. The manual was served by 16 master oscillators, each one shared by three adjacent semitones. Pressing any playing key switched the C and R components of the particular oscillator to correspond to the desired semitone, and applied a "forward" keying bias to the oscillator valve, so that the note would "speak."

The oscillators produced basic 8ft tones but two distinct waveforms were picked up from the circuitry: a near sinoidal waveform for the "Flute" voice and a complex waveform which was shaped by formant filters to produce other voices. Our articles detailed a number of elaborations which were not provided for in the original kit, the two most notable being 4ft voices, achieved by frequency doubling, and a reverberation system using the Hammond transducer/spring unit.

At the time, we envisaged the possibility of adding 16ft voices by the use of frequency dividers and we even purchased the diodes and transistors necessary for the job. However, with so much else on hand, it was pushed aside until just a few weeks ago.

This was unfortunate because the task turned out to be much less tedious than we had anticipated and the addition has increased considerably the potential of the instrument. In fact, with free-running oscillators, 16ft, 8ft and 4ft voices, with reverberation and a tweeter to boost the formant overtones, it is a far cry from the original rather limited design.

While the following observations relate particularly to the Stromberg/Playmaster kit project, they will have relevance to a number of other organs which may be in the hands of readers and which use similar design principles. These include a number of early Thomas models, the commercially produced Stromberg-Carlson organ, "Julius" organs produced by Automatic Totalisators Ltd., and organs by other smaller concerns which inherited components left over from some of the aforementioned manufacturing operations.

In fact, a 16ft voice was an optional extra on the Julius organs, at least, and we are suggesting an essentially similar circuit arrangement.

The circuit, which is no stranger to organ literature, consists of transistor bi-stable flip-flops associated with each oscillator. When the oscillator is quiescent, so is its associated flip-flop; when the oscillator is keyed, it triggers the flip-flop into operation. The signals from the flip-flops mix into a common line which can be coupled through a filter to the existing mixing facilities, by a tab switch or potentiometer, as desired.

When the original components were bought to do the job, germanium transistors and diodes were the natural — and virtually the only — choice. Nowadays, silicon transistors and diodes are plentiful and would have to be considered. However, for those who want to do the job as cheaply as possible, germanium transistors still offer the best chance of a "bargain" to the average enthusiast. Messrs National Radio Supplies, from whom we bought the original Ediswan XA101 transistors still have good stocks of them for about 35c each. Other suppliers may have something similar to offer and/or small signal diodes, either germanium or silicon.

In a situation like this, it is not possible to foresee all the odd diodes and transistors which constructors may "unearth" but our impression is that the circuit should operate with almost any diodes — germanium or silicon— and with almost any general-purpose PNP germanium transistors. If there is any doubt, it is a very simple matter to mock up a single flip-flop, power it from a couple of batteries and connect it to one of the organ oscillators. Its output can be judged visually with a CRO or aurally by feeding it into the organ common line via an isolating capacitor and resistor.

(We did not make any observations with silicon NPN transistors but it is reasonable to expect that they would function similarly, provided the triggering diodes were reversed and the transistors operated from a positive supply rail and a negative but smaller hold-off bias rail. The exact configuration used in last month's "Keyless Organ" would not necessarily be suitable because of the non-transient nature of the triggering from a Hartley oscillator.)

Knowing that the circuit, as shown, had been well proved, we resisted the temptation to debate or change it. We simply mocked it up in the rough, verified that it was not at all critical of transistors, component values or operating voltages, and that it would work with each oscillator, in turn, on the tone generator chassis. This done, we assembled a whole string of dividers on a piece of Veroboard, connected them up and had the pleasure of seeing them all work first off.

They should work just as well for other constructors.

The supply voltages to the multivibrator are not particularly critical, the Julius organ previously mentioned using supply rails of plus and minus 12V, obtained conveniently from other circuitry. We settled for a nominal plus and minus 9V, mainly because 9V is a figure obtained easily by rectifying a 6.3V RMS source. More about this later.

Referring to the circuit diagram, T1 and T2 are PNP transistors, interconnected to form a bi-stable flip-flop (or multivibrator). In the absence of input drive signal, the flip-flop assumes a stable condition in which one transistor (either T1 or T2, randomly) is in the conducting state. Voltage drop across its collector load carries the collector towards "earth" potential and, with it, the base of the other transistor. This, combined with the positive "hold-off" bias applied through the base return resistor holds the second transistor well beyond cut-off.

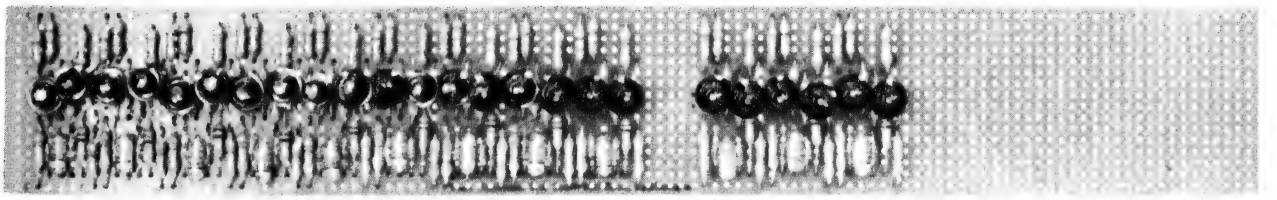
Signal input for each flip-flop is picked up from the plate of its associated oscillator valve through a capacitor which can typically be a .001uF plastic type. This blocks the DC and also acts as a differentiating capacitor in association with the 10K resistor, so that the triggering will depend as much as possible on the harmonic content of the input waveform. At the same time, the relative values of R and C will largely determine the amplitude of the signal at their junction.

The differentiated drive signal is coupled to the two bases by diodes D1 and D2.

Negative-going half-cycles of the input signal can have no effect on the flip-flop since, for such signals, the diodes represent a virtual open circuit.

For positive-going signals, a different situation obtains.

Assume, initially, that T1 is conducting and that T2 is cut off. In this case, the base of T2 and the cathode of D1 will be at a positive potential; no signal current will flow through D2 until — or unless — the



input signal swings the anode more positive than the cathode.

However, no such delay is present for D1 and the full positive-going signal excursion is therefore able to reach the base of T1, causing a sharp fall in its collector current. The resulting negative-going excursion is coupled to the base of T2 by the RC coupling network. Because the charge across the large 0.1uF capacitor cannot change rapidly, the negative-going excursion at the base of T2 will be sustained, even though some component of the original positive-going signal may reach it via D2.

Under these conditions T2 will conduct, its collector potential will approach earth and the charge across its 0.1uF coupling capacitor will force T1 further into cut-off. In other words, the circuit will "flip over."

Since flip-over will occur on each positive half-cycle of input signal, two such half-cycles will be required to carry the flip-flop through one complete cycle of operation. Hence its divide-by-two function.

The 0.1uF "commutating" capacitors across the 33K cross-coupling resistors are much larger than in normal practice but they are necessary to ensure that the circuit will operate reliably from the drive signal available from the Hartley oscillators in the organ. Musically this may represent a "complex" tone but it is far too regular to be anything like a good triggering waveform. However, with 0.1uF capacitors in the position shown, the circuit does trigger reliably, even with full bias modulation applied to the oscillators to secure a vibrato effect.

The 0.1uF capacitors were atttached to the copper side of the board, partly for reasons of space and partly because we wanted to keep them accessible for possible change. In fact, being low voltage ceramic types, most of them turned out to have a value nearer to 0.15uF but we chose to retain them, because of their advantage in terms of size and price.

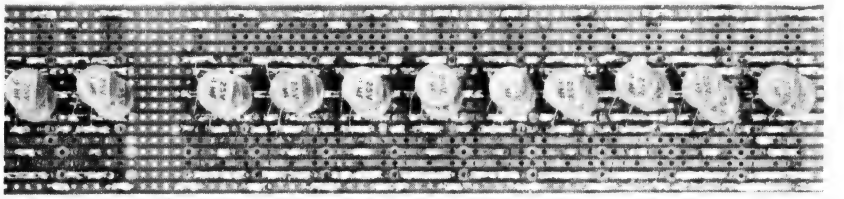
Viewed on an oscilloscope, the output from the multivibrators is far from square, but this is of no great consequence. Before reaching the amplifier, the signal has to traverse a low-pass filter, which removes most of the high order harmonics, anyway.

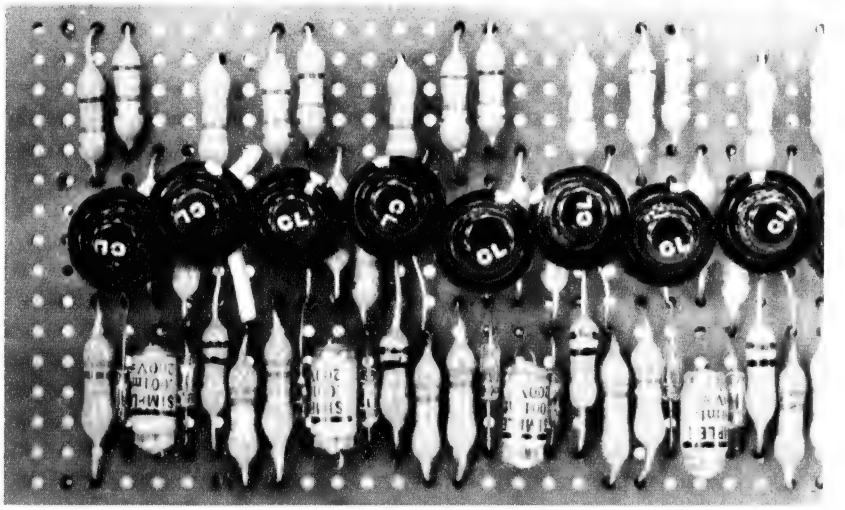
The amplitude and shape of the input signal to the flip-flop depends largely on the value of the input coupling capacitor. A value of .001uF proved satisfactory from A above middle-C (A-440) to the top of the manual; this, in fact, involved 7 flip-flops. For the two oscillators serving the 6 semitones below A-440, capacitors of .0015uF were used, while the middle-C oscillator used .0018. For oscillators lower in frequency again, progressively larger values would be required, values being chosen to ensure reliable division to half frequency. With unduly large values for any given oscillator, operation is likely to become erratic, the flip-flop attempting to operate at the original drive frequency.

The remaining components do not call for any special comment except perhaps for the 82K resistors; if you have any difficulty in obtaining them, 100K could be used instead.

As far as construction is concerned, the physical layout of the flip-flops is not at all critical but there is everything to be said in favour of a neat, workmanlike job. We laid the flip-flops out on a piece of Veroboard, 17in long, 2-5/8in wide and carrying 16 copper tracks.

The diagram indicates the placement parts used for the original board; the supply, output and earth rails, and the interruptions to the other tracks to obtain the appropriate connections. Using this layout, it is possible to accommodate 16 multivibrators on the board to serve a 49-note manual, leav-





*Pictured at the top is a 17-inch length of Veroboard carrying 12 multivibrators. Note the space left at the end and centre for support brackets. The underside of a section of the board is shown at centre while, immediately above, is a close-up of 4 multivibrators reproduced about normal size. A diagram overleaf indicates how the copper tracks are utilised.*

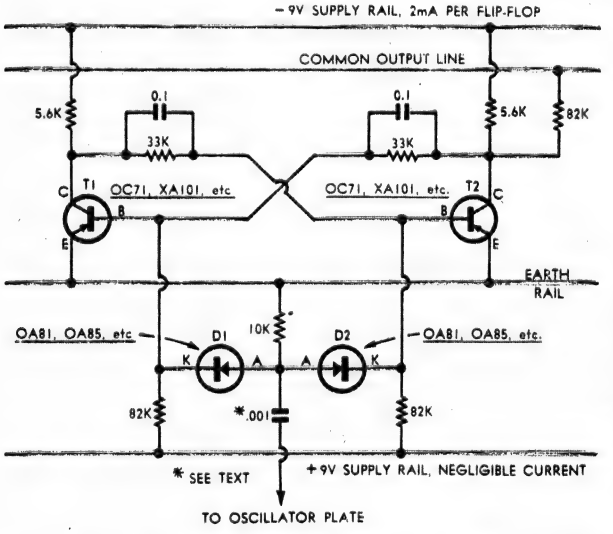



*Figure 1: The circuit of a divider flip-flop. Germanium transistors have been used because suitable oddment types are likely to be available at half the price, or less, of silicon transistors.*

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ing space at both ends and near the middle to accommodate supporting brackets.

The accompanying photographs show the board with 12 multivibrators in position, wired for the 12 oscillators serving the right-hand end of the manual. Note that there is a 2-hole space to accept an end mounting racket and a 5-hole space between multivibrators 9 and 10 to accommodate a centre mounting bracket.

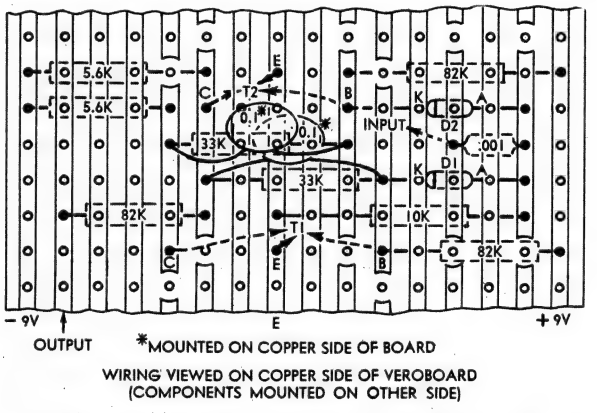


*Figure 2: In wiring up the board, start with the highest frequency multivibrator. Remember to leave room for the end support bracket and arrange the components carefully as per this diagram. Check it for operation with the topmost oscillator in the organ. All other stages will be an exact copy, apart from the input coupling capacitor.*

The support brackets were bent up from strips of 16g aluminium to the approximate dimensions shown, three being required. The far end of the bracket, as drawn, clips inside the bottom front lip of the tone generator chassis, as normally hung in the organ console. The near end of the bracket can be secured under the nearest inductor mounting plate screw, the end of the bracket being offset as necessary and drilled to align with the screw.

The divider board can rest in the brackets, copper pattern up, and locked to the brackets by 8BA screws and nuts. Don't forget to interrupt the copper tracks where the screws pass through, to prevent earthing of the circuitry. There may be other ways of mounting the board of course, but the one suggested is simple and obviates the need to drill holes in the generator chassis.

When the job was started, we were not certain whether the 16ft voice would be wanted over the whole manual or only part of it and we therefore worked progressively from the treble end, judging results as we went.

Our recommendation is that, for a single manual instrument, the 16ft voice be provided for the right hand only, from middle-C upwards. We found that, with 16ft over the whole manual, attempts to produce pleasant blends for the right hand produced a "muddy" left-hand accompaniment. We tried tapering the 16ft away below middle-C hence the odd number of flip-flops on the board — but still did not like the result. The simplest approach is to break at middle-C and avoid playing across the break, as much as possible.

It is noteworthy, in this context, that 16ft is seldom provided on the lower manual of spinet organs. By the same token, if the circuitry described in this article is used for a 2-manual instrument, it should be extended to cover the whole of the upper manual.

As stated earlier, the supply voltages to the multivibrator are not particularly critical and may be derived from a 6.3V source. If a winding is available grounded by one side, the voltage doubling arrangement of figure 3 can be used to provide the necessary −9V for the collectors. The series resistor shown as 470 ohms can be varied to provide the required voltage, according to the number of flip-flops connected. The 100K resistor is there

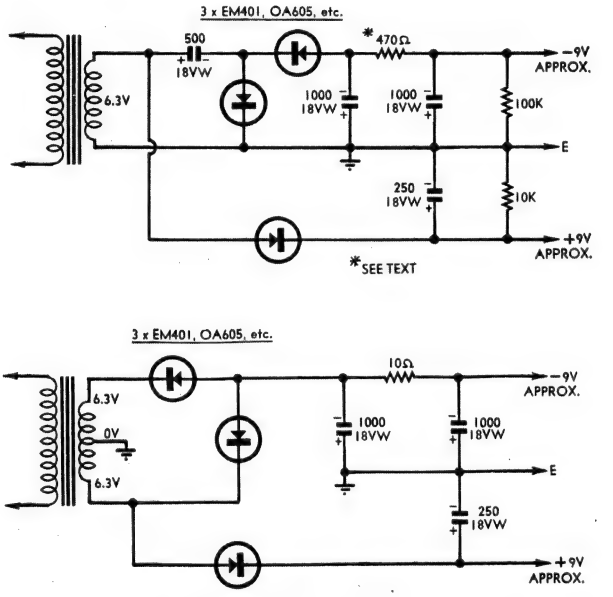


*Figure 3 (top) and figure 4 (bottom) show alternative power supply arrangements which can be used to supply multivibrators for either a full manual or half-manual system, as required. Hum level is negligibly low.*

simply to reduce the possibility of the transistors being connected to the supply when it is supposedly switched off, but still charged to 18-odd volts.

The alternative power supply shown in figure 4 uses a small separate transformer with either a 12.6V CT secondary or two 6.3V secondaries, which can be series-connected. It has much better regulation than figure 3 and can be used without alteration for either 10 or 16 flip-flops.

As distinct from the collector supply, the positive hold-off bias can be provided by a single half-wave rectifier and a modest storage capacitor.

It may be noted that 18VW capacitors have been shown in the supplies mainly for the reason that small heater transformers, when lightly loaded, may deliver a good deal more than 6.3V. If the supply is not likely to exceed 6.3V, capacitors of 10VW rating could be used in all positions except the output of the voltage doubler.

Depending on circumstances, the supplementary supply can be accommodated within the main amplifier or assembled in a small utility box. In our case, we used a box measuring 5 x 2¼ x 2¼ inches, bolted to a vacant spot on the loudspeaker baffle.

The raw signal on the common line from the dividers has a rather buzzing quality, due to the presence of higher order harmonics.

Some filtering is highly desirable to produce a smoother, more musical tone, to merge with the other and existing voices.

The recommended coupling and filter circuit is shown in figure 6. An 0.22uF capacitor blocks the DC from the common line and feeds into an inductor and capacitor which, together, form a low pass filter. From the junction, the signal is taken to a 500K potentiometer. In the original organ the potentiometers were special types with 180-degree rotation only but these are not readily available. We settled for an ordinary 270-degree log. pot. which was mounted in place of the full-organ switch. In the kit organ, this had already been rendered rather redundant by the knee switch and relay arrangement described in May, 1962.

The signal is applied to the common line in the organ by a 470K resistor, a value which provided a good ensemble with the control pot. at 180 degrees, but which allowed the 16ft to dominate with the pot. turned fully on. The value can be modified as necessary to suit individual requirements.

Reverting to the inductor, a value of about 1 Henry will resonate at about 800Hz, which is just marginally above the frequency of the top F, 16ft. With a choke of this value, there is no trace of buzz in the tone, which has a pleasant "woody" quality, well suited to use as a solo voice for the upper manual of a two-manual instrument.

As the inductor value is pushed up towards 3.5H, the resonance diminishes towards 400Hz and the resulting 16ft tone becomes smoother and less woody, particularly in its upper register. As such, it is probably somewhat more suitable as a foundation voice for a single maunal instrument. Individual constructors may compromise, of

# Forum

## Reactions to novice transmitting licences

In the December, 1968, issue, Mr Rex Black made out a case for the granting of "novice" type transmitting licences in addition to the normal Amateur Operator's Certificate of Proficiency. If the two letters which follow are any indication, there is some reservation here about the wisdom of such a move.

**Conducted by the Editor**

The first correspondent, a Victorian amateur, begins on a note that would suggest that he is fully in accord with Mr Black's ideas but it turns out to be otherwise. He seems to be reasonably happy with the present situation but would presumably be prepared to listen to argument to the contrary.

Dear Sir,

The letter from Rex Black deserves wider circulation and it is to be hoped that it comes to the notice of the R.S.G.B. It would appear that they have a lot of homework to do before they can even start an equivalent of Australia's Youth Radio Scheme.

However, it is the local scent, sketchily referred to by Mr Black that interests me and it is a pity that he did not define the limits of age and technical qualifications within which he would like to see a novice scheme operate.

Nevertheless, by quoting the U.S.S.R. scheme and Mr Clarricoats' comments on young people with shorter working hours, we have a lower limit range of from 12 to 16 years.

Whilst the merits of novice licences as such can be debated interminably, the opportunity already exists within our own P.M.G. regulations for young people to sit for the examination when they are 14 years of age and to be granted a licence at the age of 15. If they pass the C.W. test — now reduced to 10 WPM — the world is at their fingertips!

This, to my mind, is a pretty fair compromise; it offers the advantage of everyone being equal in operating priveleges and avoids the disadvantages of restricted frequencies and lower power, which could be part of the conditions in any novice licence arrangement.

As far as I can determine, in Victoria, the average age of youngsters taking the Y.R.S. exams leading to the A.O.C.P. is around 15 years, so the present system appears to be tailored to P.M.G. requirements.

However, the advocates of a novice system have lower technical standards in mind or, to be fairer, a less stringent theoretical examination.

Personally, I would not like to see a lower standard adopted. I believe that any form of amateur communition today requires the minimum already demanded by the A.O.C.P. examination.

Today's technically orientated youngster has the edge on his older contemporary. Our intense technological enviroment creates a mental "carrier wave" that is easier to modulate with basic electronic principles than was ever the case 20 years ago.

But perhaps we are all on the wrong track. If we defined our terms and could state more clearly the ultimate objectives of amateur radio, we might be in a better position to answer questions like the one under discussion.

(P.W., Eltham, Vic).

The second letter, from a young man in the age group concerned, is positively against the novice proposal:

Dear Sir,

I am a school student studying for the A.O.C.P. and I am about one third of the way through a course run by the Wireless Institute of Australia. I read Mr Black's letter in "Forum" (December, 1968) and I am not at all in favour of introducing "novice" licences.

Mr Black seems to have the impression that all such novices would belong to the Youth Radio Scheme and that "our Y.R.S. could operate a well supervised and efficient system involving lower level transmitting permits."

The Y.R.S. could possibly supervise its own members to some extent, but what about all the other novices who would not be members of the Y.R.S.? These people Mr Black seems to have forgotten. There would be beginners who are not really interested in amateur radio but who know enough of the basic principles to get their novice licence. These young people could introduce an element of irresponsibility and, as Mr Clarricoats quite rightly said, "possessing all kinds of illicit transmitting equipment."

One of the implications of a full licence is that the person concerned has a true interest in and dedication to amateur radio. Let us not lower the long standing reputation and the high standard of communication that the amateur has built up in Australia.

Personally, I would rather study for a year and gain my A.O.C.P. than spend a year operating a low-powered transmitter, not knowing how it worked.

Mr. Black states that, to a country with a novice system, "there must surely be some side benefits such as developing electronic mindedness among young citizens, who will be required in increasing numbers to enter the expanding electronics and scientific fields in peace time and form an invaluable pool of semi-trained personnel in case of war."

That may sound reasonable enough, but surely there are other ways of encouraging young people than getting them absorbed in the expensive business of trying to operate a small radio station. Surely there are ways in which the Y.R.S. can help without giving them a novice licence.

What is needed is an improvement in the practical and theoretical courses available and, in this respect, we should give Mr. Black and the Y.R.S. every possible support.

Let us hear what other potential amateurs feel about the subject. These are the people it affects most of all. (T. L., Gordon, N.S.W.)

COMMENT: This letter reflects the viewpoint of a young man who has decided that he wants the full A.O.C.P. and, perhaps predictably, he shows little sympathy for those who want to proceed along different lines. Nor does he make any allowance for the incentive which a communication facility can give. For some lads, at least, club-room instruction may not provide the incentive to stay with electronics until they reach an age and a stage where they can, with confidence, tackle the full A.O.C.P. examination.

His fears about the dreadful things non - Y.R.S. novices might do also ignores the fact that these novices would be licensed and subject to the discipline which such a licence implies. In this respect, their position would not be very different from that of any other licensed amateur.

Having presumably passed an examination and obtained a licence it is reasonable to assume that the young person concerned has a genuine and awakening interest in technical electronics and a respect for the licensing authority.

His position would be quite different from the person who buys a couple of C.B. type equipments from a discount house, tears up the covering sheet setting out licence requirements, and proceeds to fill the air with gabble, devoid of technical content or interest.

## Tones on the mains

In the editorial in the October issue we raised the matter of control tones on power lines and emphasised that they could cause special embarrassment in church and public buildings using amplifier systems and electronic organs. It is most disturbing, during proceedings, to hear a series of 1000-odd Hz tones reproduced at an annoying level through the loudspeaker system.

The editorial produced some quite interesting reactions, some expected, some not so.

One was from a reader in Castle Hill, NSW, who had not so long ago installed a good quality stereogram in his home. It worked fine except for one thing: every now and again it would produce quite noticeable whistles. He'd become involved in discussions as to the possible cause of the trouble and those concerned had reached the conclusion that the unit must be suffering from an intermittent condition, resulting in instability.

Since the trouble seemed to appear for brief intervals only on odd occasions, there was little chance of it being found by a visiting serviceman. Tentative arrangements were in train for the stereogram to be taken back to the supplier's service shop for a long-term run, in the hope that the trouble could be identified and corrected.

When the set owner came across our editorial, he began to wonder and observe. He soon realised that the whistles were not random but followed definite patterns and that they happened usually on the hour or half-hour. They still annoy him but at least he and his supplier have been spared the problems of abortive service procedures.

It certainly causes one to wonder how many futile service calls and arguments have resulted from this same cause.

In support of this observation, I quote a letter from Gordon, N.S.W.:

*Dear Sir,*

*I have just been shown your editorial in the October issue of "Electronics Australia." So that is what the noise is. I've been getting quite jumpy about it and thinking that there was something wrong with my gear. It is most anything, a sound that goes whee-e-e for up to half a minute.*

*I was in a hall last night where they have put in new fluorescent lights. There was no music being played, no equipment switched on, apart from the lights. Just people talking—when this high pitched note came on, quite distinctly.*

*Please object on my behalf.*

*(Signed but initials withheld by request.)*

From a church in Granville, N.S.W. comes news of a problem something similar to the one mentioned in the editorial — whistles from the amplifier which regularly punctuated the evening service. According to my informant, when they were first noticed, they caused a certain amount of amusement: the preacher who was still going when the amplifier whistled was over time. But amusement has long since given way to annoyance.

From Bulimba, in Queensland, came a rather simliar report.

A church in Merrylands, N.S.W., supplies a story with an extra twist. The control tones are audible through both the electronic organ and the

**(Continued on page 64)**

## FM STEREO MULTIPLEX, UHF TV

*Dear Sir,*

*Being an Australian, or "emigrant wallaby," who works in the engineering department of one of the San Francisco television stations, I feel obliged to express certain opinions about the Australian television and radio scene — using what has happened here as a yardstick.*

*I understand that, on the basis of receiver sensitivity, range, etc., plus some 1950 style soothsaying, the Australian Broadcasting Control Board decided that FM was a "seven day wonder," which hadn't "made it" in the United States. Further, that the adoption of UHF channels for television would be an economic tragedy, with UHF converters of the day so unstable, etc.*

*Perhaps one shouldn't blame the powers that be (or were), for their opinions were justifiable enough at the time a decision had to be made as to how the VHF spectrum should be chopped up. I understand that the FM band in Australia is gone.*

*What really prompts me to write is a reference in the October issue which seems to imply that FM is still a toy here. This couldn't be further from the truth. At last count, there are something like 20 FM broadcasting stations in the San Francisco Bay area alone, the majority of them transmitting FM stereo multiplex. Any stations not already doing so, plan shortly to convert their equipment.*

*I feel that FM stereo multiplex is what has rocketed FM broadcasting ahead here. The number of FM receivers available leaves no room for the would-be FM sponsor to fear that his message will not be heard. The receivers range from Hi-Fi outfits to pocket models retailing for as low as $9 in the local drug store (at that price generally Japanese imports).*

*Car stereo tape players are almost a standard line in upper-bracket cars, but after the initial enthusiasm, it is found that owners don't rush to buy tape libraries for their cars. But the sale of a stereo FM adaptor, the size of a tape cartridge and quite reasonably priced, has reached record proportions. This plugs ingeniously into the tape player's "mouth," so to speak.*

*Several Japanese manufacturers, including Hitachi, offer a just-larger-than-pocket-size multiplex FM/AM Hi-Fi portable with "lid" loudspeakers.*

*The fact that stereo multiplex is fully compatible for the older FM mono receivers is the primary reason why it has become so successfully "airborne" here.*

*There is a wealth of untouched broadcasting to be done in Australia other than that Saturday afternoon nightmare: all-over-the-dial football. There could be a real lift to manufacturers also, with all the groundwork already done over here.*

*I note from page 31 of your October issue that the University of N.S.W. has a UHF TV transmitter. Perhaps we should have gone for UHF television. It is ideal for just about any small prime target areas. The number of channels available, plus its inbuilt line-of-sight coverage, offers great advantages for regional TV, with freedom from the overlapping that has been experienced in Australia with VHF TV.*

*While the cost of the U.S. 82-channel receiver was higher than the last VHF-only unit built some five years back (the F.C.C. now bans VHF-only designs) receivers generally have since dropped considerably in price, including colour receivers. With the present improved techniques, UHF presents no manufacturing problems whatsoever in either the transmitter or the receiver.*

*(R.G., San Rafael, California.)*

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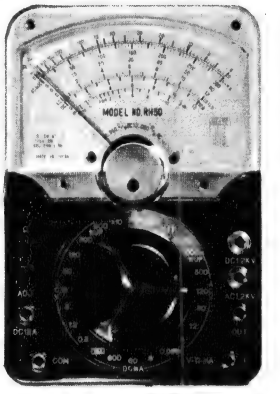


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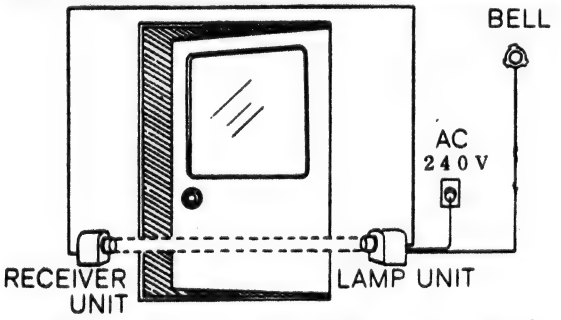
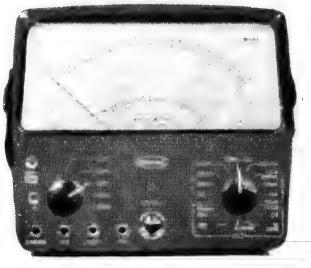



**Photo-electric Alarm** operates when beam of light across entrance, 20-50 ft., maximum, is broken by intruder. No wires or moving parts. This magic eye can be connected to a bell or light to announce the entrance of visitors, etc. 240 V. mains required.

**$39.00 or $40.00 posted.**

## NEW MODEL A-10 MULTIMETER AND SIGNAL INJECTOR

**With Test Leads and Injector Probe**



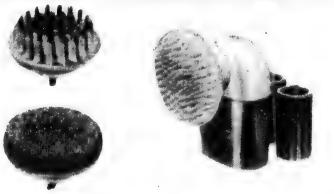
**30,000 O.P.V.**

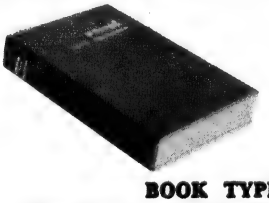
**SPECIFICATION:** 6in x 2½in scale.
**DC Voltage:** 0-0.5, 2.5, 10, 50, 250, 500, 1,000 V at 30,000 o.p.v. 5,000 and 25,000 V at 10,000 o.p.v.
**AC Voltage:** 0-2.5, 10, 50, 250, 500, 1,000 V at 10,000 o.p.v.
**Volume Level in Decibels.**
**DC Current:** 0-50 uA, 1, 50, 250 mA, 0-1 and 10 amps.
**AC Current:** 0-1, and 10 amps.
**Resistance:** 0-10K, 100K, 1M, 100 Megohms. Signal Injector Output Jack. Zener Diode Overload Protection.

**Price $54.00**

**"RIAM"** Swiss-made battery-operated Vibratory Massager comes complete with two batteries, three applicators and instruction sheet.

**$8.50 or $9.00 posted.**





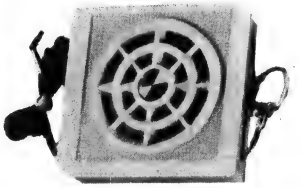
**XMAS SPECIAL**

**$19.95**

**BOOK TYPE**

The latest model portable Tape-recorder. 4 transistor, 3in Reels, 2 track. Instruction manual. Size 10¼in x 7in x 1¼in.
Just open the book and record. Supplied complete with tape, microphone and batteries. Special discount price:

**$19.95 posted anywhere.**



**"CONION"** transistorised **SIREN ALARM** can be used for personal protection or as a burglar alarm. Loud siren sounds for 20 minutes when cord is disturbed. Pocket size, easily concealed.

**$11.75 complete. Posted, $12.00.**

**PORTABLE PLAYS 33 x 45 RECORDS**

**SIZE 9½" x 5½"**

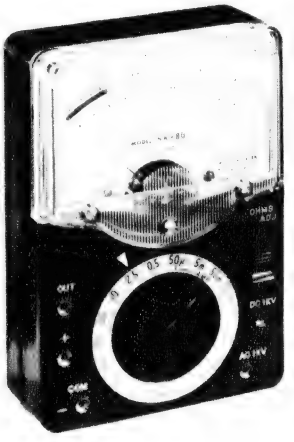
**ALL TRANSISTOR RADIO**
Phonograph. Complete
**$45.00**

# NEW R H 1969
**(RADIO HOUSE)**
**RANGE OF**
# MULTIMETERS

**Features:**
**High sensitivity, minimizes the loading effect to the circuit under test.**
**Wide coverage of measuring ranges.**
**Clear, plastic dial covering for easy and accurate measuring**

- **Double-jewelled ±2% meter**
- **±1% temperature-stabilized film resistors.**

## MODEL SK-80



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

**Specifications:**

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current: 50uA, 5mA, 50 mA, 500 mA

Resistance. 5 kΩ, 50kΩ, 500kΩ, 5 MegΩ

Decibels. +10 −62lb.

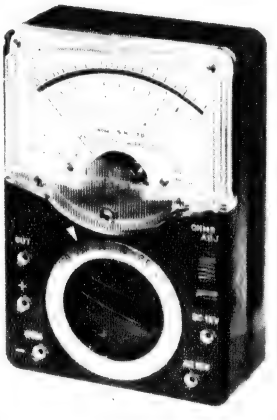
Accuracy. DC±3%, AC ±4% (of full scale)

Batteries. Two 1.5V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale.

**$18.00** ***Postage 50c.***

## MODEL SK-70



30,000 Ohms per Volt DC
10,000 Ohms per Volt AC

**Specifications:**

DC Volts. 0.5, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 50 uA, 5 mA, 50 mA, 500mA

Resistance: 7 kΩ, 70 kΩ, 700 kΩ, 7 MegΩ

Decibels. −10 +62 db

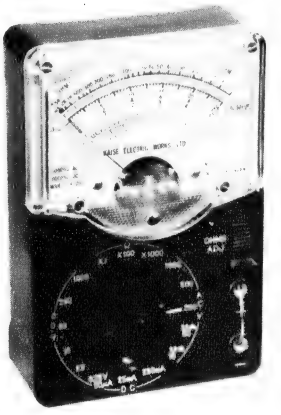
Accuracy. DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale.

**$22.50** ***Postage 50c.***

## MODEL SK-20



20,000 Ohms per Volt DC
10,000 Ohms per Volt AC

**Specifications:**

DC Volts: 0.25, 2.5, 10, 50, 250, 1000 (20,000/V)

AC Volts: 10, 50, 250, 500, 1000 (10,000/V)

DC Current. 50 uA, 25mA, 250mA

Resistance. 7kΩ, 700kΩ, 7MΩ

Decibels. −10 +22 (at AC/10V) +20 +36 (at AC/50V). Upper frequency limit 7kc.

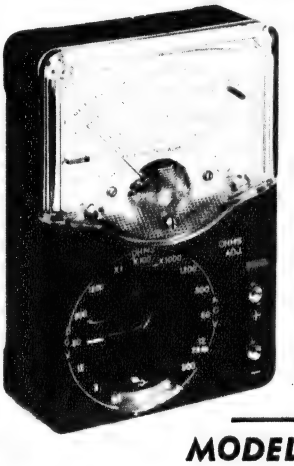
Accuracy. DC ±3%, AC ±4% (of full scale)

Batteries: Two 1.5V dry cells. Size AA, "Eveready" 915

● 16 Positions heavy duty switch.

**$13.95** ***Postage 50c.***

## MODEL SK-55



30,000 Ohms per Volt DC
14,000 Ohms per Volt AC

**SPECIFICATIONS:**

*DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V (30,000 ohms/V).

*AC Volts: 12V, 60V, 300V, 1200V (14,000 ohms/V).

*DC Current: 60 A, 12mA, 300mA.

*Resistance: 10K ohm, 1Meg ohm, 10Meg ohm.

*Decibels: −10db +23db.

*Meter Sensitivity: 23 A.

● Overload-protected by dual silicon diodes. ● Mirror scale.

**$20.00** ***Postage 50c.***

## MODEL SK-60

50,000 Ohms per Volt DC
10,000 Ohms per Volt AC

**Specifications:**

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000 V

AC Volts. 10, 50, 250, 500, 1000 V

DC Current. 25 uA, 5 mA, 50 mA, 500 mA

Resistance: 10 kΩ, 100 kΩ, 1 MegΩ, 10 MegΩ

Decibels. −10 +62 db

Accuracy: DC±3%, AC± 4% (of full scale)

Batteries. Two 1.5 V dry cells. Size AA, "Eveready" 915

● Overload-protected by dual silicon diodes. ● Mirror scale.

**$25.00** ***Postage 50c.***

**NOTICE**

**The 6-8 Royal Arcade address will close down in June 69 during the re-building of the Arcade.**

# RADIO HOUSE PTY. LTD.

**306-308 PITT STREET: 6 ROYAL ARCADE & 760 GEORGE STREET, SYDNEY**

# FORUM — continued

amplifier system but, for good measure, the control tones at 7.30 p.m. each Sunday evening, are followed by a sharp rise in the hum level of the amplifier!

Presumably this has something to do with a change in the reticulation arrangements and a change in earth currents in the area. As such, it is probably a different problem from the tones themselves requiring some modification to the microphone wiring and/or amplifier earthing.

Getting away from churches and public halls, I had a call from someone who is — or has been — connected with a large P.M.G. installation in the Newcastle area. The problem here, allegedly, is with control tones upsetting the operation of voltage sensing equipment. To use his words:

"It's driven us up the wall."

Two quite separate calls came from linesmen working in areas where control tones appear on the 440V distribution mains. Their conviction was that high frequency control tones superimposed on high voltage distribution lines increase the danger to linesmen working with live circuits. Both were convinced that certain accidents which had occurred were due to an aggravation of conditions already rather hazardous.

A nasty thought, indeed.

A final comment came from an electrical engineer whom I know quite well. He made the observation that his own industrial organisation had decided not to install control tone equipment in their plant because, at the levels of sensitivity at which it was proposed to operate, the equipment was itself too prone to malfunction, due to impulses from arc welders and other heavy electrical equipment.

He suggested that reticulation authorities may be winding up the amplitude of their control tones to achieve greater immunity from random interference.

On matters of reliability, staff safety, and interference to and from industrial equipment, I have no other information at present. But one thing is certain: the control tones do interfere with audio equipment in homes, halls and churches and they're a confounded nuisance!

## *Telescope drives*

By way of a welcome change from untimely whistles in amplifiers, let's turn to a letter from a reader who has something to say about telescope drives:

*I noted your reply to a correspondent in the June, 1968 issue where you say that a Wien Bridge oscillator would not have sufficient stability for driving a telescope motor. In view of the number of people who are apparently interested in the idea of a crystal-controlled power source, I feel that I should point out a few things about the subject.*

*The first is that the telescope does NOT require to be driven at a constant speed. What is referred to as "sidereal speed" is an approximation only and needs to be slower near the horizon than near the zenith (over-*

**(Continued on page 85)**

KEEPING UP WITH

# semiconductors

## . . . the "regenerative gate" SCR

A thyristor or SCR cannot switch from the blocking to the fully conducting state instantaneously; a finite time is required for the charge conditions appropriate for the conducting state to distribute evenly over the three device junctions. Accordingly when anode-cathode current initially flows as a result of gate triggering, it is localised in the area of the junctions closely adjacent to the gate contact. Only after a short "spreading" time does the current distribute evenly throughout the device cross-section.

Because the initial conduction is confined to a relatively small portion of the junction cross-sections, the device is initially capable of withstanding without damage only a fraction of its full rated current capacity. The effective current-carrying capacity of the device rises as the current distributes over the junctions, however, so that protection of the device from damage involves limiting the rate of increase of conduction current so that it does not exceed the rate at which the junctions "turn on." Thyristor manufacturers therefore specify for their devices a maximum allowable inrush current rate (di/dt), which typically has a value between 30 and 200 amps per microsecond.

In general the thyristor device itself cannot significantly limit the di/dt rate occurring in a circuit, so that the necessary limiting must be provided by external circuit components such as air-core or saturable inductors in series with the anode. In high power rectifier and converter circuits the provision of such "slow-down" components can be a problem; quite apart from this, the need to restrict rate of current change tends to limit the normal thyristor to applications involving relatively low frequencies. This is particularly true at high power levels.

As there are many potential applications of both low and high power thyristors at high frequencies, there is strong motivation to seek ways of raising the attainable di/dt rating. Accordingly device designers and manufacturers have tried a variety of gate-cathode geometries other than the more-or-less "classic" side-fire structure shown in figure 1(a).

Some have used a "centre-gate" geometry, in which the N-type cathode layer forms an annulus or ring around the edge of the P-type gate layer. Although in theory this should distribute the initial conduction evenly around the periphery, in practice this doesn't occur; current starts to flow at a particular point on the junction, more or less as before. The time needed to reach full conduction is reduced, making the device more suited for high frequency operation, but the di/dt capacity is not dramatically improved.

Other variations have included a "ring gate" structure, in which the metal gate electrode is extended as a ring around the surface of the P-type gate layer, and multiple gate systems in which a number of independent gate electrodes are triggered simultaneously. These give small improvements in turn-on speed, but again no dramatic increase in di/dt rating. And in general the gate sensitivity of the device is lowered, so that higher-power triggering circuitry is required.

Little progress was made until it was discovered that an important part

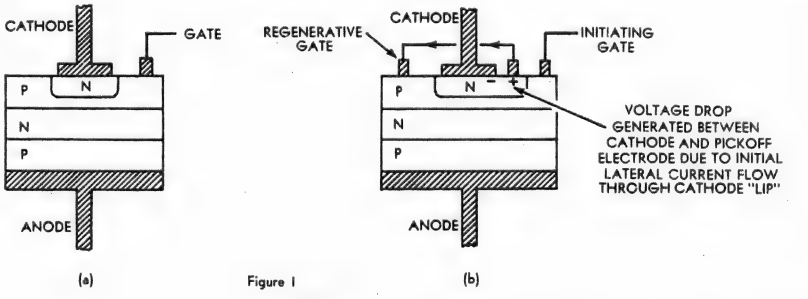



Figure 1

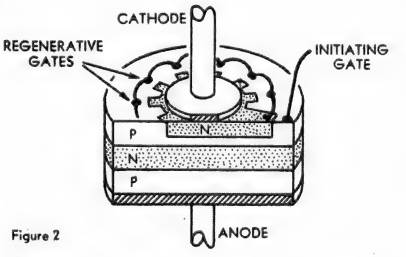



Figure 2

could be played by the emitter "lip" —the portion of the N-type cathode layer which is not covered by the metallic cathode electrode. It was formerly thought that the cathode electrode should be made to cover as much of the cathode layer as manufacturing tolerance restrictions would allow; however experiments showed that if the electrode were reduced in area to produce a wide lip, not only was there a suggestion that the di/dt rating of the device increased slightly, but the device also exhibited a strong tendency to self-limit the circuit di/dt.

Analysis revealed that a radial or "transverse" voltage drop was set up in the resistance of the emitter lip, as a result of the localisation of the initial conduction current at the side of the cathode layer nearest the gate electrode. This voltage acted as a "back EMF" or current-proportional negative feedback voltage, and by opposing the gate drive in a localised fashion it both forced the conduction current to "spread" away from the initial area, and also tended to slow down the rate of conduction.

Unfortunately the degree of conduction slow-down tended to outweigh any improvement in di/dt rating, showing that simply increasing the emitter lip area was not the answer. However the new light which had been shed on thyristor turn-on provided a groundwork for an important new development, recently announced: the "regenerative gate" technique.

In essence, the new techique is almost delightfully simple. The radial feedback voltage produced in an intentionally elongated cathode lip is picked off, and used as an amplified trigger source for further gate electrodes, as shown in figure 1(b). By this means the thyristor is provided with an internally regenerative or "snowball" turn-on action; increasing current at the point of initial conduction itself produces the gate drive to initiate further "secondary" conduction centres, and so on.

Although only one regenerative gate is shown in figure 1(b), in fact a number are used. Figure 2 shows a cutaway view of typical regenerative-gate device which has an elongated lip and pick-off electrode near the initiating gate and a series of regenerative gates spaced around the cathode layer periphery. Spreading of the conduction at each regenerative gate region is encouraged by the partially interdigitated or "spoked" cathode lip configuration.

As a result of the regenerative action, the device actually turns itself on at a rate determined by the di/dt of the anode conduction current. The faster the rise in current, the faster the device turns on and protects itself against localised overheating. Not only is the device thereby protected against di/dt damage, but its turn-on speed is increased significantly.

Recently announced regenerative-gate thyristors have achieved a di/dt rating as high as 600 amps/microsecond, for load currents of 1200 amps peak and load voltages of 1000V at 60Hz repetition rates. Research is now being made towards developing the regenerative-gate concept for use at much higher frequencies. Use of a fully interdigitated or "interleaved fingers" gate structure seems to hold promise of megahertz switching speeds, even for high current devices. (J.R.). ■

# A SOLID-STATE DIP OSCILLATOR....

Battery operated, this new solid state dipper operates from 1.3MHz to 160MHz. By virtue of the fact that it is completely portable and covers a wide frequency range, it should be a popular item among amateurs and many others who find themselves dealing with resonant circuits. The uses for such an instrument are almost limitless and this article will attempt to cover some of those applications.

By Ian Pogson

Quite a number of grid dip oscillators have been described in this journal in past years, all capable of meeting the need of the particular period. As a general rule, the main improvement made from one unit to another has been a progressive extension of the upper frequency limit, although other refinements have been added from time to time. The last one, described by the writer, in February, 1964, was the most ambitious of its kind attempted so far and the original has performed well and has been more or less in constant use over the intervening years.

This latter unit could still be considered as being current, particularly if the audio facilities are required and if there is no objection to the consequent size and the limitation presented by the fact that it derives its power from the mains. Its upper frequency limit of about 230MHz would be difficult to better in a comparable instrument. Where this order of frequency is to be exceeded, the usual approach is to make an entirely separate unit.

A grid dip oscillator is a relatively simple instrument but its uses are many and varied. It may be used to determine the resonant frequency of tuned circuits; as an absorption wavemeter or simple signal generator; as a CW, SSB or AM monitor; for checking crystals; for aerial and transmission line tests; the measurement of "Q", capacitance and inductance, and so on.

A GDO is indispensable in the amateur "shack" and for all who are pursuing the construction and adjustment of equipment, where radio frequencies are involved.

As we had not thus far described a solid-state version of the more familiar valve grid dip oscillator, we decided that the time had arrived to present a unit which was battery operated as well as being small and light, thus making it a truly portable unit.

Before going into the technical details of design and construction, there is one problem which such a unit presents. It cannot be called a "grid" dip oscillator, as there is no grid involved. Some such units have been called "base" or "gate" dip oscillators, according to the type of circuit and transistor used.

This is fair enough, provided the base or gate circuit is being metered. However, due to output level and other circuit considerations, more than likely there will be a detector and amplifier preceding the metering circuit. With this in mind, and with the desire to play safe in what could be a contentious point, we prefer to dub the solid state counterpart of the grid dip oscillator, simply as a "dip oscillator." This avoids the issue nicely, without introducing any ambiguities.

The dip oscillator which we are about to describe, uses an easy-to-get RF transistor, in the grounded base configuration. With the other components available, the upper frequency which we were able to reach without difficulty is 160MHz. In point of fact, our unit goes to about 173MHz. The lower limit which we decided upon, is 1.3MHz. This overall range, which is covered with six coils, should meet the needs of most readers.

The circuit is basically a Colpitts, although this may not be evident from a casual glance at the diagram. The 6.8pF capacitor, from collector to emitter, is one section of the divider and the other capacitance is that of the emitter junction of the transistor. The tuned circuit is effectively connected between collector and base.

In order to make the oscillator function satisfactorily over such a wide frequency range, it is necessary to effect minor changes to the circuit, according to the range in use.

For the highest range, 60MHz to 160MHz, it is necessary to increase the collector current from the normal of about 1mA, to about 3mA, to obtain satisfactory oscillation. The two ranges covering from 12MHz to 60MHz need no modification. However, the three coils which cover from 1.3MHz to 16MHz must be centre tapped, thus making the oscillator a Hartley, since the Colpitts circuit does not function with the fixed components in the circuit, designed for the higher frequencies.

As the centre tap of each coil is returned to the base, a DC potential difference between the coil and the base is involved. For this reason and to control the amount of feedback in the oscillator loop, a fixed capacitor is introduced into the coil centre tap circuit. By making the value 68pF for the 1.3MHz to 3MHz range, 39pF for the 2.9MHz to 7MHz range and 10pF for the 6.5MHz to 16MHz range, the strength of oscillation is brought close to the optimum required.

These changes are made automatically, as the alterations for each range where needed, are incorporated in the plug-in coil unit.

Oscillations, as taken from the emitter, are relatively low in amplitude. These may be detected and the recovered DC component may be used to actuate a DC meter. However, this would necessitate a movement with a sensitivity of about 50uA. As such a movement would be expensive and perhaps more difficult to come by, we decided to take an alternative approach. By using an amplifier, a lower sensitivity meter can be used and this is what we did.

It would have been possible to use a diode detector, followed by a transistor DC amplifier to actuate the movement, but we elected to combine these two functions by using a class B detector. This performs the function of detection between the base and emitter and the whole transistor then acts as an amplifier.

To achieve this operation, the transistor is biased back to the knee of its curve. The meter may be inserted either in the collector or emitter circuit, but we elected to put it in the emitter. A 20K potentiometer is also conected in series with the meter, and functions as a "sensitivity" control. The emitter is by-passed to ground with a .001uF capacitor, to filter the RF component from the circuit. Finally, headphone facilities are also provided from the emitter, being blocked from DC with a 0.47uF capacitor.

Power is derived for the whole unit from a set of four No. 1015 dry cells. These are held in a moulded plastic holder, the whole assembly then being screwed to the case. This combination for the power supply was chosen as being perhaps the most economical, consistent with small space requirements. We could have used a small nine volt battery, which occupies even less space, and the cost between the two would not be very great initially. However, with the smaller size of the nine volt unit, and even if we kept the current drain to the same figures, the ampere-hour capacity would be less, with consequent more frequent renewal problems.

Whilst we are on the subject of supply voltages, the whole circuit may be operated between about 4.5 and 12 volts satisfactoritly. A result to be expected from a change in voltage is a more or less proportional change in output. For our purpose, the output when using six volts has been found to be adequate.

The last point relating to the circuit, is the switching. A simple ON/OFF switch, controls battery supply to both the oscillator and detector circuits. An additional switch of the same type switches the oscillator on or off, still leaving the detector switched on. This allows the unit to be used as a dip meter with the oscillator on, and as an absorption wavemeter with the oscillator switched off.

The components which we have used throughout are readily available

# 1.3 to 160MHz

and generally speaking, no more expensive than necessary to do the job efficiently. The transistors which we used are type BF115 and they do the job that is expected of them. As the functions that they perform are not critical on present day standards, more than likely there would be a number of alternative makes and types which would do the job just as well.

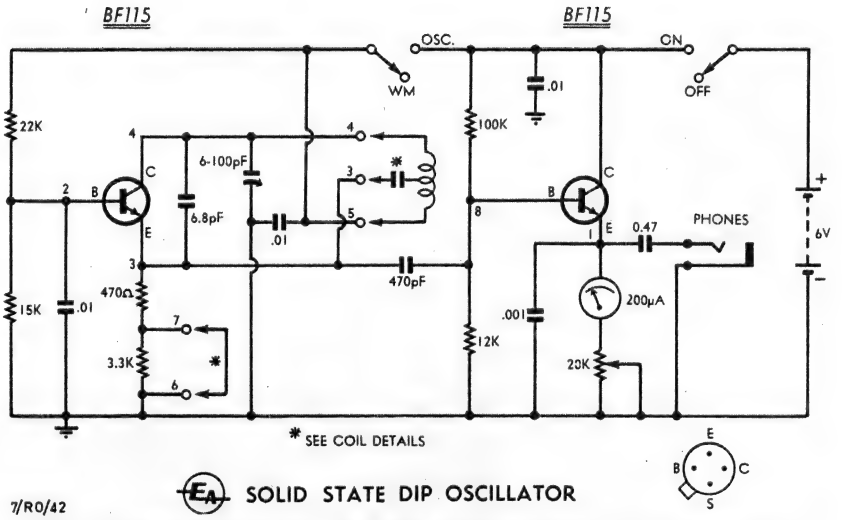
The tuning capacitor is one made by Polar and has a maximum capacitance of 100pF and a minimum of about 6pF. This is a well constructed and insulated unit and performs satisfactorily, with one reservation. Due to the shape of the plates, which gives an approximate straight line capacitance characteristic, the high frequency end of each range is rather cramped. This seemed to be about the only type of capacitor available to do the job and the amount of cramping, although undesirable, is not so bad as to restrict its usefulness. An alternative brand of capacitor is also available from the Orient, the only significant difference being the method of mounting.

The meter is one of the now familiar edgewise type. This shape lends itself to being fitted into a small space and still gives a good clear needle indication. The particular one which we used is a level indicator, simply marked "normal" and "high." The sensitivity is 200uA for full scale deflection and the type No. is V303. The scale is not important but any other type which has the same sensitivity would do.

Careful consideration was given to the type of coils and the socket for the coil to plug into. With not too much to choose from, we selected polystyrene formers, ¾in diameter and 2in long. The old reliable and easy-to-use octal socket was adopted, with matching plugs fitted to the base of each coil former. Smaller sockets were considered but we feared that they were perhaps not quite rugged enough for the type of service. In addition, the octal socket, with an abundance of unused lugs, lends itself for mounting of the vital components of the oscillator, so keeping leads short.

With this type of instrument, the dial scale is always a problem. We solved it in what we consider a satisfactory manner, by using a piece of polar white lustre Formica sheet, 2¾in square. This gives a nice white surface to work on and it is held in place with a screw at each corner, as well as by the nut on the bush of the variable capacitor. If it is not convenient to use the same material as we did, then any white surface material, such as heavy card, would be suitable. As a further alternative, we propose to make a scale available through the Information Service, for 50c. The actual calibration points will be omitted and these can be filled in to suit the individual unit.

The cursor and knob presented quite a sticky problem in this instance, as there appeared to be nothing available to do the job directly. However, Messrs Watkin Wynne have a standard line, a knob and circular perspex cursor combined, which is 3-3/16in diameter. This can be used provided it is reduced in diameter to 2¼in. This can be done readily enough if you have a lathe at your disposal. If you have not turned this material before, care should be taken to run it at fairly low speed and take very fine cuts. Otherwise, there is a danger of melting the material causing jamming and disaster generally. The alternative is to reduce the diameter carefully and painstakingly, by hand.

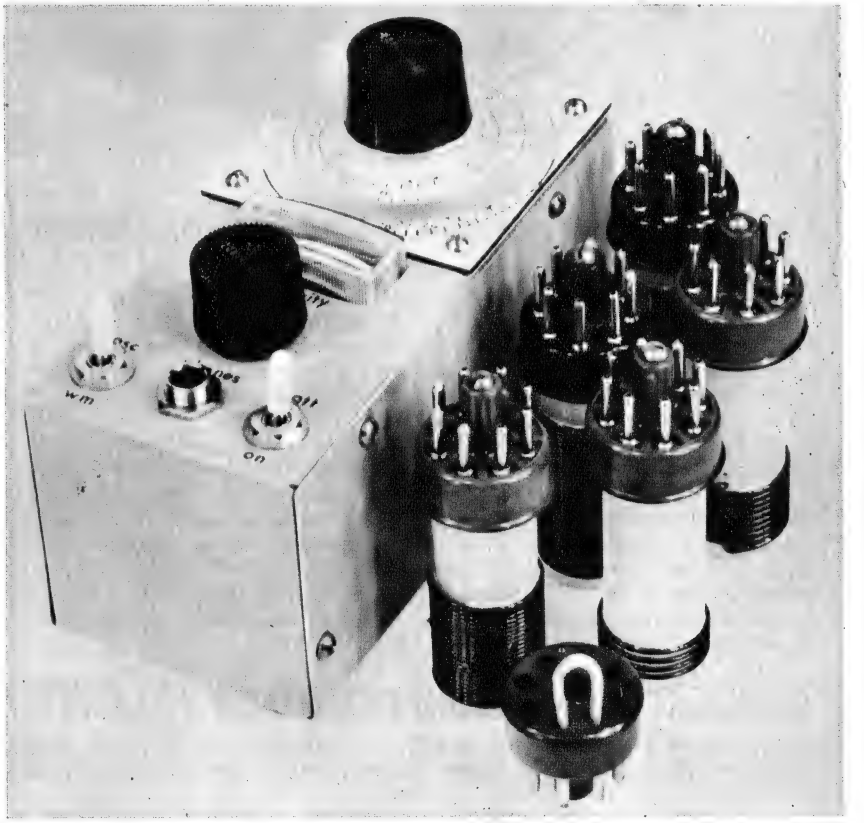



7/RO/42 SOLID STATE DIP OSCILLATOR

*The circuit is quite simple and uses only a minimum of components. Note the 3.3K emitter resistor which is short-circuited for the highest frequency range. Note also the change to a Hartley circuit for the three lower ranges. Details of the capacitor from the coil centre tap are given in the coil table.*

The resistors and capacitors, particularly those around the oscillator, should be of good quality and not some picked from the "junk box." The capacitors should all be ceramic where possible. The low values, such as the 6.8pF and those in the centre taps of the coils, should be NPO types. The .01uF units, also ceramic, should be the higher voltage and high-K type, in preference to the low voltage "Redcaps." Good quality polyester and polystyrene types may be used in other positions.

**(Continued on page 70)**



*This general view shows the unit with the full set of plug-in coils. It would be a good idea to make up a set of sockets to take the coils when stored. The whole set could then be placed in a metal case.*

# Goldring
# Trendsetters in sound equipment


## Latest release, Swiss made precision transcription unit GL75

Integrated transcription motor unit and arm, built to instrument standards of quality and appearance. The drive system is the unique Goldring-Lenco constant velocity 4-pole motor with conical shaft coupled to the underside of the turntable by a knife-edged idler (automatically disengaged by the on/off switch, which is fully click-suppressed and also operates a turntable brake).

The turntable is die-cast from non-ferrous material, weighs 9 lb and is dynamically balanced.

Speed is continuously variable from 86-30 rpm and from 18-15 rpm with adjustable positive stops for the four standard playing speeds. There is only 0.2% change of speed for 10% mains voltage change.

The transcription arm is the Goldring-Lenco L75 with knife-edge bearings, full balancing facilities, calibrated stylus pressure adjustment, and 'anti-skating' bias compensation. It is lowered hydraulically by a lever fitted to the deck plate. Shock-damping mountings are supplied with the unit.

## Goldring '800' series free field stereo cartridge

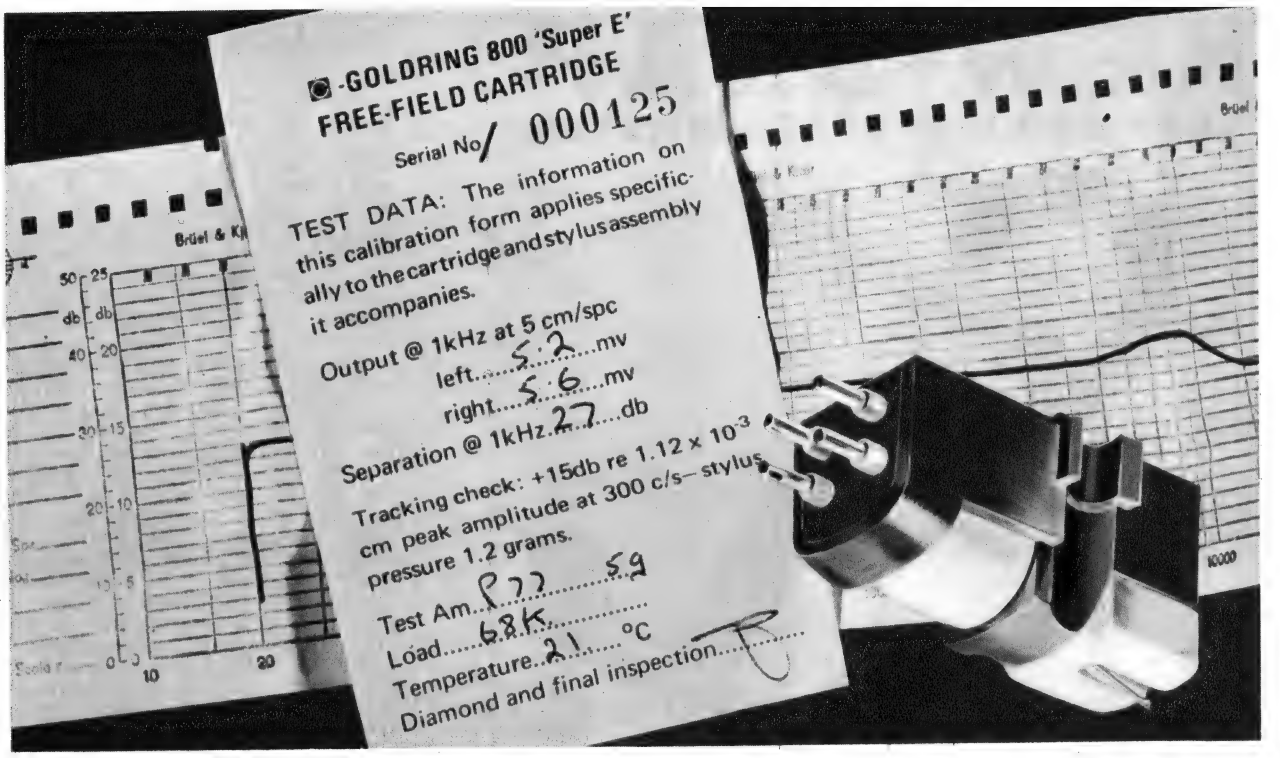
800: In this cartridge a very lightweight tube of magnetic material lies in a "free field" generated by a fixed source coupled to a low mass diamond point. It features low mechanical impedance (tracks at 1 to 3 grams), screening from external hum fields, gold-plated contacts. Stylus is replaceable. Rivals finest in the world. Frequency response 20-20 kHz, compliance 20 x 10-6.

800E: Using the same cartridge body as the standard model, an eliptical diamond stylus is fitted. Compliance is substantially increased resulting in brilliant linear, resonant free, performance. Frequency response 20-20 kHz, compliance 30 x 10-6.

## GOLDRING ENGINEERING (AUSTRALASIA) PTY. LTD.

N.S.W.: 443 Kent Street, Sydney. 29 1275. VIC.: 368 Little Bourke Street, Melbourne. 67 1197. QLD.: 235 Edward Street, Brisbane. 2 7010. W.A.: 91 Hay Street, Subiaco, Perth. 8 4988. S.A.: Ernsmith, 52-54 King William Street, Adelaide. 51 6351.

**From the ever-widening range of hi-fi equipment available from Goldring.**




# NEW RELEASE!

# GOLDRING 800 'SUPER E'

## free field stereo cartridge

## ...hand-crafted and tested for the most critical hi-fi buffs.

The 800 series, as used by the BBC, has won wide acclaim for its outstanding performance.

Now Goldring goes one step further with the 800 'SUPER E,' a cartridge capable of reproducing the complete dynamic range captured on your records. And, used with ancillary equipment having sufficient overload margins, it permits new peak loudness levels.

What's more each 800 'SUPER E's' performance is **certified.** Each one is accompanied by its own individual Bruel & Kjoer Performance Chart and Serial Numbered Calibration Form.

The 800 series is based on a very advanced principle: a very lightweight tube of magnetic material lies in a 'free field' generated by a fixed source coupled to a low mass diamond point. They feature low mechanical impedance (tracking at ¾-2 grams), screening from external hum fields, gold-plated contacts, replaceable elliptical diamond stylus.

**SPECIFICATIONS:**

| | |
|---|---|
| Frequency Response: | 10 cps-25 kc's |
| Sensitivity: | 5 mV per cm/55 sec |
| Separation: | 25 dB at 1 kc and nowhere less than 15 dB |
| Load: | 47 k-100 k ohms |
| Compliance: | 30 x $10^{-6}$ cm/dyne |
| Effective Point Mass: | Less than 1 mg |
| Stylus Tip: | Elliptical Diamond 0.0008" x 0.0003" |
| Tracking Weight: | ¾-2 grms |
| Head Weight: | 8 grms |
| Connections: | 4 pins |
| Mounting: | ½" standard |
| Vertical Tracking Angle: | 15° |

## GOLDRING ENGINEERING (A'ASIA) PTY. LTD.

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**S.A.:** 77 Wright Street, Adelaide. 51-5117

*FROM THE EVER-WIDENING RANGE OF HI-FI EQUIPMENT AVAILABLE FROM GOLDRING.*

## OSCILLATOR—continued

Turning now to the constructional details, the unit is built into a case consisting of two parts. The part including the front panel measures 5in x 2-5/16in x 2¼in, with a lip about 5/16in along each edge. The other piece takes the form of a "U" section, which fits neatly over the other piece. The material in our case is aluminium and, as strength is achieved by the folding, only a light gauge is necessary.

The two pieces are held together with four screws each side, into the 5/16in edges. As the metal is light and not suitable for tapping or for use with self-tapping screws, we used ¼in Whitworth screws, with nuts on the inside. These nuts must be held in place permanently and we stuck them into place with epoxy resin. While this was being done, each nut was held in place by its screw, leaving the U piece off. When the resin set, the screws were removed and the nuts are left permanently and accurately in position. With this arrangement, the cover may be taken off and replaced as often as needed, without loss of screw thread.

The case is sprayed grey, after an application of self-etching primer. This gives quite a professional finish. An alternative finish for aluminium is to etch it with caustic soda, using the same technique as described in pages 61 and 63 of the August, 1963, issue.

In case you are wondering, we marked the panel with "Instantype" rub-on lettering. When this is done, the whole panel is given a light coat of clear lacquer. The case which we used is one which was folded up but without any holes, and made by Heating Systems Pty. Ltd. More than likely cases with holes ready cut will be available in the near future.

The general layout of components is such that maximum efficiency is obtained from the oscillator, together with ease of operation. Just how this has been done may be seen in the photographs. Of prime importance is the relative disposition of the variable capacitor, coil socket and transistor. These must be so placed that leads are almost non-existent.

The capacitor is screwed directly to the front panel. The coil socket is mounted on the end face, near the top right hand corner, looking from the inside. The relative placement of these two items is such that the fixed plate connection of the capacitor is soldered directly to lug 4 of the socket, the coil connections being to pins 4 and 5.

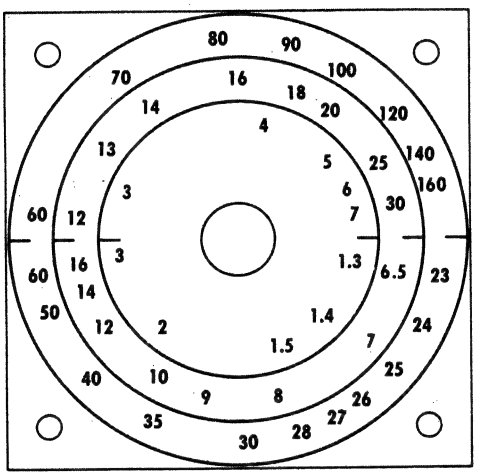
The octal socket numbers appear at various points on the circuit diagram. These indicate the actual lugs which we used to wire up the relevant components. We suggest that you follow this method, connecting each item as indicated, with the shortest possible leads. By doing this, you should be able to duplicate the original as closely as possible.

As we needed another wiring point, we used a 2-tag strip and held it under the socket screw nearest the front panel. This insulated tag is used for the collector of the detector transistor and the 100K bias resistor is strung from this point to pin 8 on the socket. The .01uF collector by-pass capacitor

is connected across the two tags of the strip and the .001uF emitter by-pass capacitor is also earthed at this strip.

The long leads from the main oscillator section, to the meter, switches and phone jack are run in light gauge tinned copper wire, with a sleeve of spaghetti tubing where necessary. If you use the same type of phone jack that we did, make sure that you wire it correctly, as normally open, rather than normally closed.

The meter may be held in place with a couple of screws and nuts, al-




*At right is a drawing of the highest frequency coil, which should be made up to the measurements shown. It may be necessary to increase or decrease the width, to get the correct coverage.*

*At left is a reproduction of the dial scale. A photographic copy may be obtained through the Information Service for 50c.*

though we did not do this, as we considered that the screw heads would detract from the appearance of the front panel. Instead, we used a light touch of adhesive on each end. The 20K "sensitivity" potentiometer is of the miniature variety, made by IRH Components. If, for any reason, you wish to use the more common and larger type of potentiometer, there is enough room to just fit it in.

The battery assembly is held in place on the back cover, with a clamp which we made up from a 7/8in wide strip of aluminium. When placing the battery, it should be located so that it clears other components on the front panel. The wiring also has to be located so that it will not foul the battery.

The plug-in coil details are given in the table. If you intend to use the dial scale which we are making available, it will be necessary to follow this information closely. On the other hand, if you intend to make up your own scale, then some deviation from the details, particularly in wire gauges specified, would be permissible. However, too much deviation from the original may make a big difference to the frequency cover of each coil.

Coils 1, 2, 3, 4 and 5 are wound on ¼in dia. polystyrene formers. These formers are closed at one end and a hole, tapped to 5/32in Whitworth, is provided for mounting purposes.

To fix the formers to the octal plugs, firstly drill a 1/8in clearance hole through the key of the plug. Actually, most of the key is hollow and only the extreme end has to be drilled. This is an easy task but care must be taken to get the hole at least close to the middle of the key. The base and former are held together with a 1½in long, 1/8in Whitworth brass screw. Push the screw through the key and then through the tapped hole in the former and screw a nut on, inside the former. However, before this is finally done, the coils must be wound.

In all cases, the top of the winding should start about 1/8in from the end of the former. This applies particularly to the higher frequency coils. This is necessary so that the end of the coil may be probed into confined spaces and give adequate coupling to the circuit under test.

Before winding a coil, the hole for the start of the winding must be drilled. In addition, the two or three holes as required, should be drilled through the closed end of the former, at points where the leads are to connect to the base pins. To locate the hole position for the finish of the winding, and the centre tap where applicable, a

## COIL DATA FOR DIP OSCILLATOR

1. 1.3MHz—3.0MHz; 136T C/T, 30 B&S en. ¼in dia., 1-11/16in long, 68pF
2. 2.9MHz—7MHz; 60T C/T, 24 SWG en. ¼in dia., 1½in long, 39pF
3. 6.5MHz—16MHz; 23T C/T, 18 B&S en. ¼in dia., 1in long, 10pF
4. 12MHz—30MHz; 10T 16 TPI, 18 B&S en. ¼in dia.
5. 23MHz—60MHz; 4T, 18 B&S en. ¼in dia., ¼in long.
6. 60MHz—160MHz; See figure 1 for details.

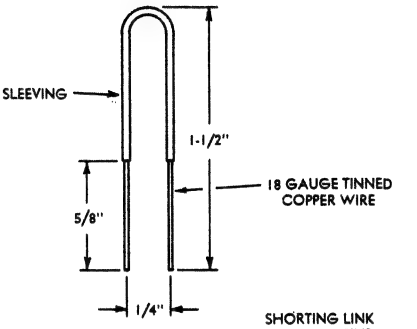


Figure 1

trial winding can be done to locate these points accurately. Having done all this, the winding is done on a permanent basis, with bared leads brought through the appropriate holes. To prevent the turns of the windings from moving, it is a good idea to run a little cellulose adhesive around the two ends and perhaps a smear longitudinally, to further stabilise the turns.

With coils 1, 2 and 3, the capacitor lead for the centre tap is brought through the hole and soldered to the winding. The capacitor is fitted inside the former, with the other lead protruding through the hole at the end. When each coil is wound, the coil leads are fed through pins 4 and 5, with the centre tap to pin 3. The coil and base are then screwed together and the leads are ready to be finally soldered to the ends of the pins.

Coil 6 consists simply of a "hairpin" of 18 gauge tinned copper wire, insu-

## PARTS LIST

*1 Panel and ends, 5in x 2-5/16in x 2¼in.*
*1 "U" box cover, 5in x 2-5/16in x 2¼in.*
*4 No. 1015 dry cells.*
*1 Holder for above cells.*
*1 Battery plug and leads.*
*1 Meter, 200uA, scale not important.*
*1 Variable capacitor, 6-100pF, Polar or similar.*
*1 Dial scale.*
*1 Perspex dial cursor and knob (see text).*
*1 Small knob.*
*2 Miniature toggle switches, SPDT, type S-2012.*
*1 Open circuit phone jack.*
*1 20K linear miniature potentiometer.*
*1 Spindle bush for potentiometer.*
*1 Octal valve socket, mica filled.*
*6 Octal plugs, mica filled.*
*5 Polystyrene coil formers, ¼in dia., one grooved 16 TPI.*
*2 BF115 transistors.*
*1 2-tag strip.*

*CAPACITORS*

*1 6.8pF NPO ceramic.*
*1 10pF NPO ceramic.*
*1 39pF NPO ceramic.*
*1 .001uF ceramic or styroseal.*
*1 470pF ceramic or styroseal.*
*1 68pf NPO ceramic or styroseal.*
*3 .01uF ceramic.*
*1 0.47uF low voltage plastic.*

*RESISTORS*

*(10 p.c. ½ watt)*

*1 470 ohms.* *1 15K.*
*1 3.3K* *1 22K.*
*1 12K.* *1 100K.*

*SUNDRIES*

*Screws, nuts, solder lugs, solder, hookup wire, etc.*

lated with a piece of spaghetti sleeving and made up as shown in the diagram. In addition to the "coil" across pins 4 and 5, a shorting link is wired permanently between pins 6 and 7.

The question of calibration naturally arises as soon as construction is complete. There are a number of methods which may be used, according to the facilities which happen to be available. Perhaps the easiest method is to use an accurately calibrated receiver. It is only necessary to receive the signal from the dip oscillator and read off the frequency from the receiver dial.

As a general rule, communications receivers are calibrated up to 30MHz. Above this frequency, unless a VHF receiver is available, it is necessary to resort to other methods.

An absorption frequency meter may be used, if such is available. The coils of the absorption meter and the dip oscillator should be loosely coupled, just sufficient to give an indication on either unit. That is to say, a rise in meter reading will be observed on the absorption meter, at the same time as a dip occurs on the dip oscillator meter. This method is not generally as accurate as some others, but should be sufficiently accurate for most purposes.

Naturally enough, another dip oscillator may be used for calibration. One unit can be used in the same manner as the absorption frequency meter, that is, with the oscillator supply switched off. Although the sensitivity is not as good as with the absorption frequency meter, it will only require a little closer coupling.

An alternative method when calibrating against another dip oscillator, is to plug a pair of headphones into the "phones" jack of one of the units. The oscillator to be calibrated is zero beat against the other, which is set to known frequency intervals. For this procedure, the two instruments may be placed further part, sufficient to give a well-defined "zero."

A crystal frequency standard can also be used for calibration. Check points will be available every 100KHz or 1000KHz, for example, or whatever happens to be the fundamental frequency of the crystal being used.

An RF signal generator is a very satisfactory method, more particularly if it covers the full range over which the dip oscillator is intended to operate. When using either a frequency standard or signal generator, the output should be brought out to a loop of two or three turns, slightly larger in diameter than the coil to be checked. The loop should be brought just close enough to the coil to give an audible beat in the headphones. It is also often helpful to switch on the modulation tone, if the generator has this facility.

Some of the methods described may be limited in the available frequency coverage and more than one method may have to be used to complete the calibration. The harmonics from a frequency standard may be only audible up to a certain limit, for example. On the other hand, the idea of using harmonics of the calibrating signal should not be overlooked.

Here may we offer a word of warning. In all the processes of calibration, great care should be exercised to ensure that the fundamental frequency of the

dip oscillator is the one being measured.

Where difficulty is experienced in obtaining reference signals above 30MHz, there are still means of getting some spot frequencies at least, even if full calibration cannot be realised. In many cases, amateurs will have VHF converters on 52 and 144MHz from which spots may be taken. The multiplier stages in a two-metre transmitter, on 48 and 72MHz may also be used.

In addition to the above possibilities, the various TV stations are also useful. Each station will give two frequencies, one on the sound carrier and the other for the vision, 5.5MHz apart. Even if certain channels are not occupied in your locality, a rough idea may be obtained by merely blacking out the receiver screen on the unused channels.

Another method for calibration of the VHF ranges of the dip oscillator is the use of Lecher lines. Briefly, a Lecher line consists of two parallel taut wires securely fixed at each end so that the spacing is constant throughout the length. The actual spacing beween the lines should not be greater than 2 per cent of the shortest wavelength which has to be measured. The length of the lines should be at least one wavelength long and they should be air insulated, except at the ends.

The wires must be bare copper and a shorting bar capable of sliding the full length, must be provided. The set-up is, in effect, an open wire transmission line. Such a line shows very definite resonance effects and by actually measuring the distance between two points of maximum current, a half wavelength can be fairly accurately determined.

In use, the dip oscillator to be calibrated is loosely coupled to a half-turn wire loop connected to the line at one end. The slider is moved along until a dip is indicated on the meter. This point is accurately marked. The slider is moved along further, until another dip is noted. The distance between the two points is half a wavelength.

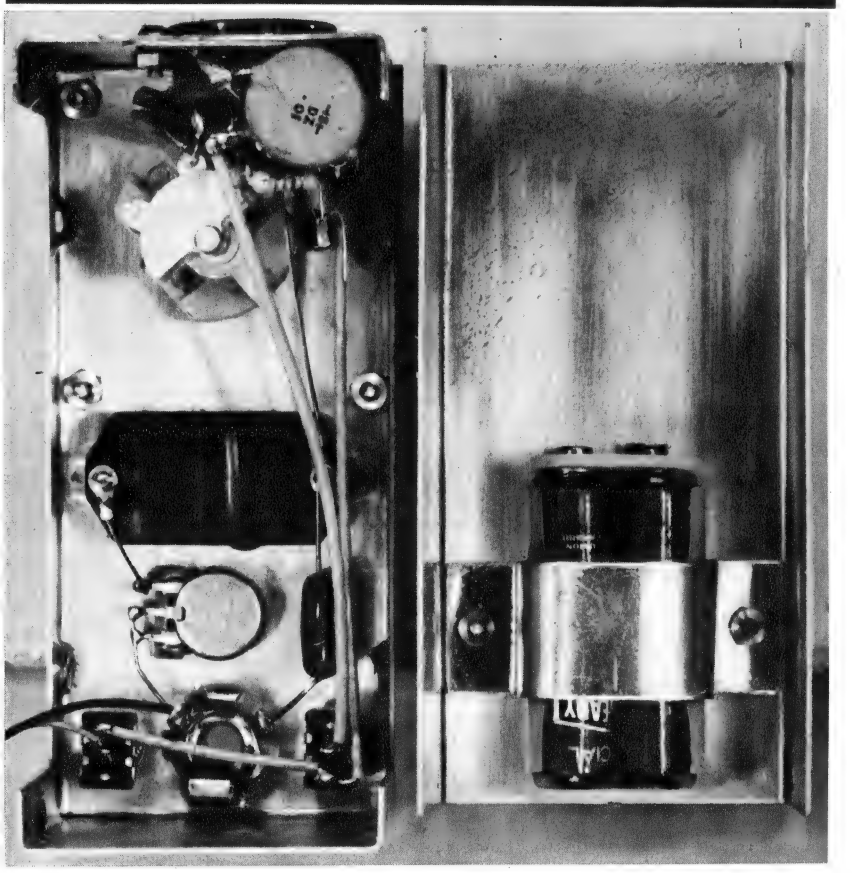
The formula for calculating the actual frequency is given by: Freq. MHz=15000/Distance between two points in centimetres. For those who would like further information on this method, reference may be made to the RSGB Handbook, pp 467-8 and the ARRL Handbook, chapter on Measurements, in the older editions and up to at least the 1955 edition.

That just about exhausts our suggestions for calibrating your dip oscillator which, we trust, will enable everyone to carry out this interesting and important task. As mentioned previously, one or more of the methods outlined may be used. In fact, it is quite a good idea to use as many methods as possible as a cross check.

The main function of a dip oscillator is to check or make measurements on various types of resonant circuits. Many other applications revolve around this primary function. Some of those checks which may be made and which involve the principle of resonance may be listed as follows:

The process of ascertaining the resonant frequency of tuned circuits. Closely allied to the above function is that of the absorption wavemeter. The measurement of capacitance and inductance. The measurement of the "Q" of a tuned circuit. Aerial and transmission line tests.

## INSIDE VIEW OF THE OSCILLATOR



*This picture of the "inside" shows the relative location of components, with particular emphasis on the method of clamping the battery. Note also the need to keep the long leads out of the way of the battery space.*

To find the resonant frequency of a tuned circuit, the circuit to be tested must not have power applied. With the appropriate coil plugged in, the dip oscillator is brought near to the circuit to be checked.

As the dip oscillator is tuned across the resonant frequency of the circuit, energy is absorbed by the circuit under test. This effectively results in a reduction in the feed back of the oscillator, with a consequent drop in level. As the meter measures this level, the reduction shows up as a dip in the meter. The meter dip also gives a relative idea of the "Q" of the circuit, being deepest when the "Q" is high.

There are numerous applications which come under the heading of checking the resonant frequency of a tuned circuit. Such tuned circuits can take on various forms. They may be the coils in a receiver or transmitter, hidden circuits causing parasitic oscillations in transmitters, the resonance of an RF choke, aerials, etc.

Where resonant circuits which are energised are to be checked for frequency, the instrument is used as an absorption wavemeter. This is simply done by switching off the oscillator. Energy from the tuned circuit is picked up by the coil and is rectified and amplified by the detector. This shows up as a current indication on the meter. For the most accurate reading the coupling should be loose, as in all other previous examples.

As it is possible to measure resonant frequencies with the dip oscillator, it naturally follows that it would be possible to measure capacitance and inductance. Where a coil of known inductance is available, the unknown

**(Continued on page 76)**

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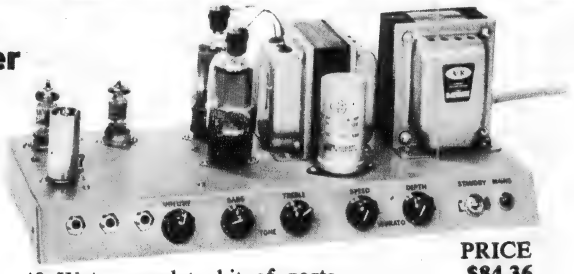

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| 40 Watt built and tested | $91.49 |
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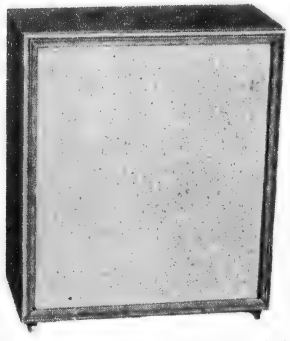

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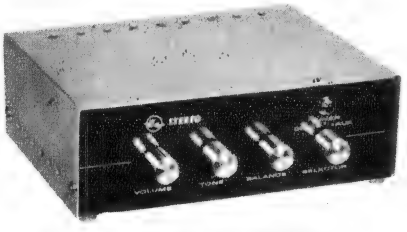

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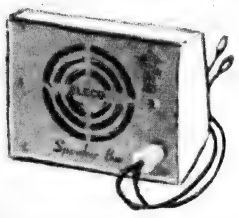

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1—Philips driver bit
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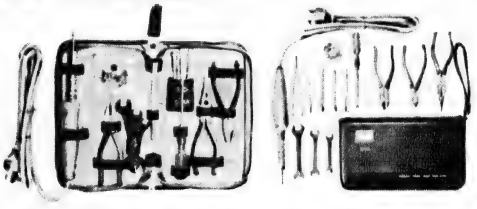

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## OSCILLATOR—continued

capacitor is connected across the coil, using the shortest possible leads. The capacitance may be calculated, with the known inductance and the measured frequency.

The formula for this is given by:

$$C=25{,}400/LF^2$$

where C is in pF, L in uH and F in MHz.

If a coil of known inductance is not available, there is an alternative method, provided a capacitor of known value is available. The known capacitor is placed across any coil which will resonate with it in the required frequency range and the frequency is measured. The known capacitor is removed and the unknown substituted. The frequency is measured again.

The capacitance may be calculated by the formula:

$$C = F_1^2 Cs / F_2^2$$

Where C and Cs are the unknown and known capacitances in pF, respectively. F1 and F2 are the frequencies with the known and unknown capacitances, respectively.

To ascertain the inductance of a coil, the same procedure is used. A known value of capacitance is required, which is connected across the coil with the shortest possible leads. The frequency is measured and the inductance is calculated by the formula:

$$L=25{,}400/CF^2$$

Where L is in uH, C in pF and F in MHz.

The frequency of a crystal can also be determined with the dip oscillator. The crystal is placed in a socket. A loop of hookup wire of about two or three turns, has its ends terminated, one on each terminal of the crystal socket.

The coil for the expected frequency is placed in the dip oscillator and the coil is brought near the loop. A very sharp dip will indicate the series resonant frequency of the crystal. This method will usually reveal the third and sometimes higher overtone frequencies.

In its role as a simple signal generator this versatile little instrument may be used for receiver alignment. As the signal is unmodulated, it will be necessary to measure the voltage developed across the diode load or AGC line, with a VTVM. If an "S" meter is fitted, this will serve in place of the VTVM.

Yet another use which the transmitting amateur may put the dip oscillator is that of monitoring both CW and AM signals. A pair of headphones are plugged into the "Phones" jack and CW signals may be monitored by beating the oscillator against the signal. AM signals are monitored by switching off the oscillator.

It would be quite easy to carry on with the descriptions of other uses to which the dip oscillator may be put. However, those already mentioned should give food for thought and no doubt this will lead to other ideas coming to mind. If you have not had one of these instruments before, you will soon be wondering how you got along without it in the past. ■


# KNOW WHAT YOU'RE LOOKING FOR

As an exercise in futility, a serviceman working on a set for which he has been given no symptoms or history must be pretty close to the ultimate. Yet, in many large organisations, this approach seems to be the rule rather than the exception. The inevitable result is customer dissatisfaction.

A typical example is this rather unusual story of an intermittent fault in a TV receiver. It had been tackled by another organisation before I came on the scene and is unusual because, although I located the fault and the other organisation did not, I was able to find the fault relatively easily by reason of what had been done before I came on the scene. So the credit is not all mine.

The complete story, as I ultimately pieced it together, went something like this. The fault was obvious mainly during the switch-on cycle and only on very rare occasions did it show up during a program. (In fact, when it was all over, I was inclined to wonder why the owner had made all the fuss about it that he had. I have concluded that there are two types of customer; those who will tolerate anything, and those who will tolerate nothing. However, who am I to complain?)

When first switched on, the set would usually warm up in the normal manner and produce picture and sound after about 30 seconds. This would continue for about another 30 seconds—although the time varied—then suddenly the set would go dead; no sound, no picture, no raster. After about another 20 seconds the set would start to come good, first with a very snowy picture, then changing to a normal one. The whole cycle would normally occupy two to two and half minutes. Sometimes there would be only one cycle per switch on, sometimes there would be as many as three in rapid succession. Then the set would settle down for the night.

The set was covered by a service contract and the servicing organisation involved was a very large one. And, while I was not able to obtain all the details, I did establish that the firm had made six calls concerning this fault, all in the space of one month. On at least two occasions it had been taken back to the workshop, one of these being the most recent. It had been kept in the workshop for a fortnight, eventually being returned with the comment that no fault could be found with it.

It was apparently this last incident which so exasperated the owner that he swore he would have nothing more to do with the firm concerned, and sought somebody else's advice; mine, as it happened.

It might be appropriate at this point to consider in some detail why the owner had felt so strongly about the situation as to call in a new serviceman. In doing so I am not necessarily interested in criticising the particular firm. What I am trying to do is to present the situation as seen through the eyes of the customer, in order to point up what I consider are weaknesses in service organisations generally, and large ones in particular.

But, large or small, it doesn't do any of us any harm to take a look at things from the customer's point of view now and again.

In the first place the owner was quite willing to accept the fact that the fault was a tricky one and that it might take more than one attempt to find and fix it. He might even have been prepared to accept the six attempts if it had appeared that any progress was being achieved. But, as far as he was concerned, there was not. For one thing, every time he reported that the set was still faulty, a different mechanic was sent to fix it. This created an impression of a cold, impersonal attitude on the part of the firm, with little apparent regard for any special problem which this case represented.

It was also extremely frustrating to have to start from scratch and go through a lengthy rigamarole for the benefit of each new mechanic, in order that he should have a clear picture of the problem and the history of the previous calls (as far as the customer's side of it was concerned) with nothing important overlooked.

This, to me, appears to be a major fault with many large service organisations. While I don't really believe it is true, one would be pardoned for imagining that the firms concerned employ a "frustration expert"; a very zealous individual whose job it is to see that there is as much discontinuity in handling a problem, and as many communication barriers between customer and mechanic, as it is possible to devise.

The dispatch of a different mechanic to deal with the same problem on six successive occasions is one example. Another is the fact that the mechanic who calls at the customer's home, listens to the customer's story, asks the appropriate questions, and (hopefully) observes the fault in operation, is not the one who will tackle the job on the bench. The latter has to depend on the accuracy of the former's observations, the astuteness of the questions he has asked and, most important of all, his ability to convey an accurate impression of the symptoms he has observed; an ability which is sadly lacking in many cases.

Which brings us to the events surrounding the sixth and final call which the customer made to the company; the call which ultimately proved to be the last straw as far as the customer was concerned. It was bad enough that he was without his set for a fortnight, although he was sufficiently philosophical about this to go out and hire a set for a month to cope with the anticipated delay. What really rankled was that the time in the workshop achieved nothing, apparently due to the effectiveness of the communication barriers erected by our "frustration expert."

The mechanic who called on the last occasion had appeared to get a good grasp of the situation. He wrote a detailed account of the symptoms — I subsequently saw this on the duplicate docket — which was almost identical with that which I have already given at the beginning of the article. And to it he added, underlined, a warning that the trouble would only appear when the set was switched on from cold and that it was useless to run the set for long periods waiting for it to appear.

Yet, when the set was ultimately returned, there was a large sticker affixed to the back of the chassis, saying, "Set tested for a fortnight. No fault in evidence." Whereupon the owner switched it on — and the fault appeared immediately. Considering the history of the fault, that it would appear almost without exception when switching on from cold, the owner was not prepared to accept that the factory staff could not have observed it had they tackled the problem in the right way. And, having observed the set's behaviour myself, I can only agree with him completely.

Finally, there was the confusion over delivery. The owner had specifically requested that the firm ring his home before delivering the set to ensure that his wife would be home to receive it. This request had been written in large letters across the docket. But did they? Not a bit of it. The delivery van called completely unannounced, found nobody home, and left a note under the door requesting that the owner ring the firm and make arrangements for a suitable delivery date!

A small thing?

Don't you believe it. The pet hate of any housewife is a firm whose delivery section does not keep appointments or follow simple instructions. And who can blame them? It is no joke sitting at home all day, waiting for a promised delivery which does not eventuate. Or having to ring the firm concerned and battle through the switchboard to find the appropriate staff member in order to clarify the

situation; a situation which should never have been allowed to occur.

When I mentioned this point to one of my colleagues, he agreed with me completely.

"When I tell a customer I will call at a certain time, I make sure I can—and do—keep the appointment. If a real emergency occurs and I am prevented from keeping it, I make sure I phone the customer and advise them. I am convinced that this policy is as much responsible for my reputation as a serviceman, as is my technical skill."

I couldn't have said it better myself!

This, then, was the background to the customer approaching me, and the mood he was in was understandable. Nevertheless, I wasn't keen to become involved in the dispute, for a number of reasons. When I realised that the set was still under service contract, I tried to persuade the owner to continue with the original firm. After all, as I pointed out, it was costing him no more, regardless of the number of calls involved, and he was surely entitled to demand satisfactory service for the lump sum he had already paid.

However, he was adamant. Costs and similar factors notwithstanding he simply wanted the set fixed. And, since he was convinced that the contract firm was incapable of doing the job, he was determined to take it elsewhere. He didn't actually say as much, but I gathered that if I didn't want the job he would quickly find someone else who did. I also gained the impression that nobody he knew would ever have anything to do with the contract firm if he had any say in the matter!

When I finally set the chassis up on the bench and gave it a trial run, it very obligingly repeated the symptoms I have already described. Then I tried to work out what might conceivably create such an effect. My first impression was that it was an AGC fault; partly because the snowy behaviour during part of the cycle suggested this kind of fault and partly because the particular make and model of set is rather prone to AGC faults.

So I started checking the AGC system. It didn't take me long to realise that the previous mechanics who worked on the set had had the same idea, because most of the minor components had already been changed. And much the same situation seemed to apply to any section which I mentally nominated as a likely suspect; someone else had been there first and replaced the most likely components. All in all, they must have replaced several dozen components. Which was fine from my point of view, since it meant that I didn't have to check them.

In fact, it was while I was checking through which components appeared to have been changed, that I found my first clue. The IF strip contains three IF valves, one 6EH7 and two 6EJ7s in that order. The screens to the first two valves are fed through 2.2K dropping resistors from the HT line and by-passed with .0018uF plastic capacitors. The third valve uses a similar arrangement, except that the dropping resistor is reduced to 1K, in series with a second 1K serving as a decoupling resistor, with the junction between the two by-passed with a .0033 plastic capacitor.

My attention was drawn to these three latter components because, first, the 1K decoupling resistor had obviously been replaced and, second, closer inspection of the other 1K resistor, which was somewhat obscured by other components, showed that it had suffered some overheating. Slowly, from the distant past, came dim memories of another case involving overheated screen resistors in a somewhat similar situation. I decided that the idea justified further investigation.

First, I let the set run long enough to ensure that it was well and truly warmed up, then I quickly disconnected one end of the .0018uF capacitor. Result: complete loss of picture, sound, and raster, exactly as when the set misbehaved. Even more convincing, however, was the behaviour of the 6EJ7 and the two 1K resistors. All three overheated badly, the valve glowing red inside and the resistors giving off clouds of burning paint.

The explanation? An intermittent, temperature-conscious .0018uF screen by-pass. Without a by-pass the 6EH7 goes into violent oscillation, completely gumming up the IF amplifier and, I suspect, the A.G.C. system as well. At the same time it draws several times as much plate and screen current as it should, hence the overheated screen resistors.

But, to me, the most intriguing aspect of the story was the fact that someone before me had come within an ace of finding the trouble, but had failed to notice the second faulty resistor or, if they noticed it, failed to attach any importance to it. Perhaps the fact that it was not readily visible, or easy to get at, may have had something to do with this. Anyway, the end result was that someone else did most of the hard work and I scored most of the credit.

The story also draws attention to one method of confirming a suspected cause of intermittent operation, namely, deliberately creating the suspected condition on a more permanent basis and noting whether the symptoms are the same. While not absolutely conclusive, it provides a very valuable guide. In this case, confirmation of the diagnosis was provided by conducting a lengthy series of switch-on cycles. When every one showed up perfect I considered the case proved.

But there is more than a technical lesson to be learned from this story. Earlier, I made the facetious suggestion that problems like those of which my customer complained were deliberately created by the service organisation's "frustration expert." In fact, of course, there is no such real person and no such deliberate intention. Nevertheless, he does exist in the form of red tape, apathy, incompetence, and lack of imagination.

It would be foolish to suggest that any organisation, large or small, can be run efficiently without rules and without paper work. But it is just as foolish to suggest that an organisation can survive if it loses sight of the fundamental reason for its existence; to provide a smooth, effective repair service for its customers. Fail to do this and you fail to produce satisfied customers. And without satisfied customers an organisation cannot exist.

So, when these two requirements—the need for rules and paper work on the one hand, and the satisfaction of the customer on the other—are at variance, it is time to take a long hard look at the system as a whole and see what is wrong. It may be that certain rules or procedures—born of some long-forgotten decision—are so out of touch with reality that they should be scrapped forthwith. Or, it may simply be that a procedure which works for 95 per cent of cases is wrong for the remaining 5 per cent, involving difficult or unusual ones. If so, then someone should have the authority to use his imagination and do whatever appears to be most logical to give customer satisfaction.

And, in assessing the merits of any system, an ideal standard to aim for is the kind of direct customer/serviceman relationship which exists in a one-man shop. If something approaching this can be retained within a large service organisation—at least for the difficult situations — then there is a chance that the customer may get the best of both worlds; the efficiency which can undoubtedly result from a large-well-run organisation, plus some of the pleasant personal relationship which is a normal feature of the smaller service shop.

The worst possible impression any organisation can create is one of apparent apathy to the customer's particular problem. An impression that, once his appliance disappears into the vast network of the organisation, it will be treated on a mass production basis without any regard for the particular problems or symptoms which he went to so much trouble to detail in the first place—an impression which was completely justified in the case I have just related.

★ ★ ★

On quite a different theme, here is a story about an unusual sync fault. The customer complained that the picture rolled whenever he changed channels, claiming that this continued for about 10 seconds after selecting a channel. Frankly, I treated this latter comment with some reserve. It is not unusual for the picture to roll briefly on changing channels, if the vertical hold is out of adjustment, but it seldoms lasts for more than a second or so. Once the picture drifts into position, it normally locks immediately. I could think of nothing that would allow the picture to roll for as long as 10 seconds, then come good. I assumed that the customer's sense of time was not good.

However, when I checked the set on the bench, I realised that he had been quite accurate. The set behaved exactly as he described it. My first reaction was to re-adjust the vertical hold control, even though I doubted whether this was the real answer. In fact, all that this revealed was that there was no inclination of any kind for the picture to lock during this 10 seconds. One could twiddle the hold control back and forth and roll the picture in either direction without producing so much as a hesitation as it went through the normally locked position. It was exactly as if there were no sync pulse present during that 10-second period.

This seemed to be as good a clue as any, even though I couldn't begin to imagine what would cause loss of sync pulses for only 10 seconds. However, I fished out the CRO leads and a copy of the circuit and began checking the sync pulse path. The set was a fairly old one and featured separate sync separators for vertical and horizontal circuits. It used a 6BL8 for these functions, the triode portion being the horizontal separator and the pentode the vertical one.

My first test was on the plate of the vertical separator. Sync pulses were normal here until I changed channels, whereupon they disappeared for the 10-second period, then suddenly grew out of nothing and assumed normal proportions. I next checked the line from the video amplifier to the grid of the sync separator. The full video signal, complete with normal sync pulses was present here, as it was when I moved the prod on to the grid of the valve. Well at least I had localised the fault, even if I still couldn't imagine what the cause might be.

It was while meditating thus, and looking over the section involved, that the probable cause of the trouble virtually presented itself. The grid resistor for the sync separator was a 2.7M running from grid to chassis, except that the latter connection consisted of a blob of solder with the pigtail tucked in a little pocket in the centre of the blob. I told myself that if it wasn't a dry joint it was the best imitation I had yet seen.

A gentle tug on the pigtail confirmed my suspicions, the wire moving easily in the pocket. Using the blade of a screwdriver I exerted pressure on the pigtail and forced it against the solder. With the other hand I flicked the tuner from channel to channel. Result: virtually instant lock in every case. On the other hand, pulling the pigtail right out of the solder restored the 10-second delay characteristic. So I had found the fault, even if I still wasn't exactly sure why the set behaved as it did.

Normally, the loss of a grid resistor in such a circuit would cause complete sync failure. Excessive negative bias would be built up on the sync separator grid due to grid current flow with each successive positive going sync pulse, the current flowing through the grid capacitor until the latter was fully charged. It would then remain in this condition, in theory indefinitely, because it would have no path through which it could discharge.

My tip is that, in this case, there was enough leakage through the capacitor to partly replace the inoperative grid resistor, but was so much higher as to give it a relatively long time constant, i.e., about 10 seconds. It also seems likely that the first few sync pulses received from a newly selected channel would be higher in amplitude than normal, due to the brief period needed for the AGC system to adjust itself to the signal level. During this period, the grid capacitor would be charged to a relatively high voltage, biasing the grid into a non-operative condition until the charge could leak off through its own resistance.

The capacitor, by the way, was an old paper type. I replaced it with a plastic type, as well as banishing the dry joint with the aid of a hot iron and some good old-fashioned paste flux. ■

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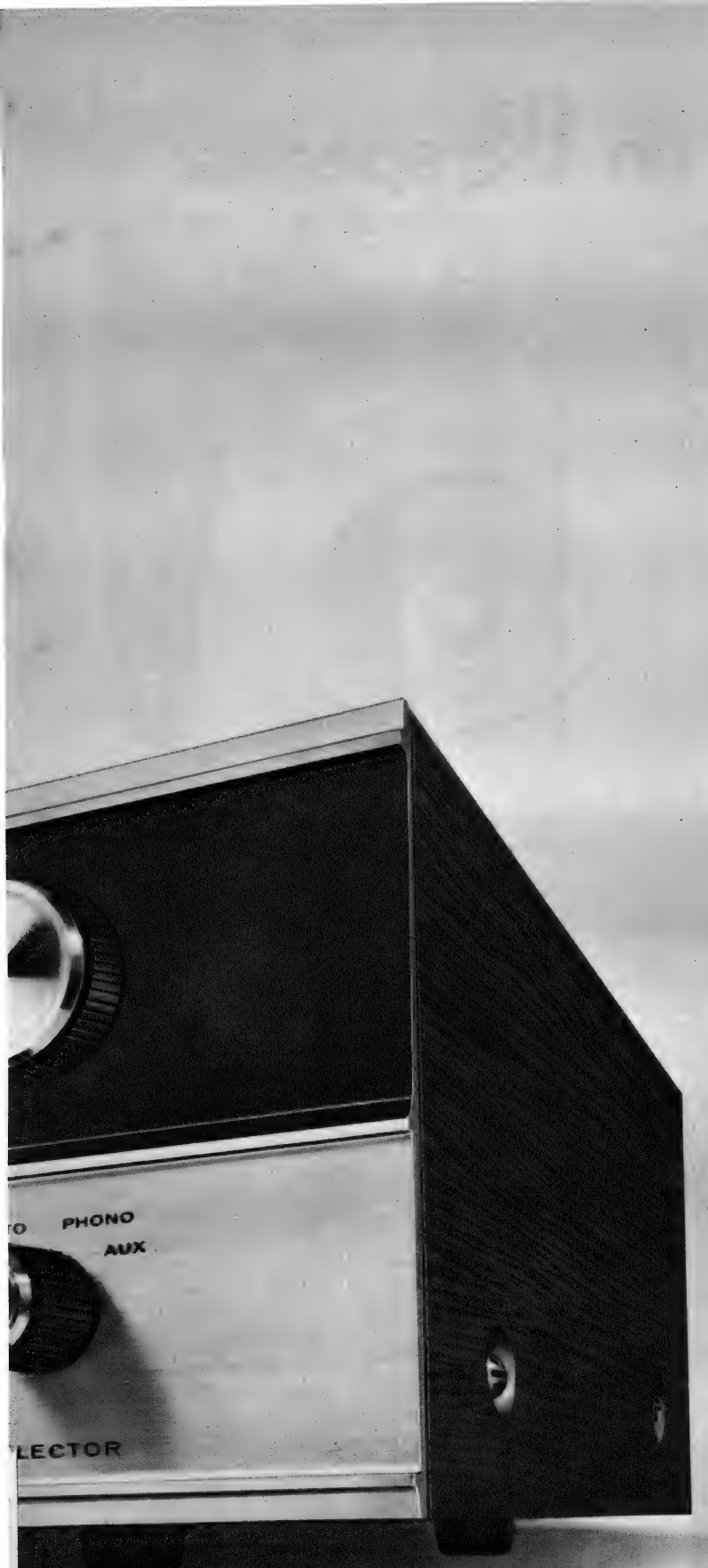


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# Treble Boost Preamplifier For Your Guitar

Following the numerous requests from readers for such a unit, we are presenting a treble boost preamplifier for use with electric guitars. Being self contained and independent of any external power supply the unit may be used with any guitar amplifier system to provide up to 26dB boost at 3KHz with reference to 300Hz.

**By Anthony Leo**

In a "pop" music group, more often than not, the balance of instruments is given over to electric guitars. Essentially, there are two distinct types used, bass and rhythm, with the latter played either as a simple rhythm accompaniment or featured as a lead instrument.

As a lead instrument playing melody, it is usual to expect that a rhythm guitar will be provided with more than normal treble emphasis. Indeed there seems to be no limit to the amount of treble boost required by some lead guitarists. Nevertheless, a discreet application of treble boost is desirable as a highlight for the melody section and to add interest generally.

Quite often the required boost is within range of the amplifier's normal tone controls together with local tone controls on the guitar. However, the controls associated with the guitar are purely passive networks providing limited bass and treble cut only. As such, when used, they tend to reduce the effective guitar output and diminish, to some extent, the average level of sound.

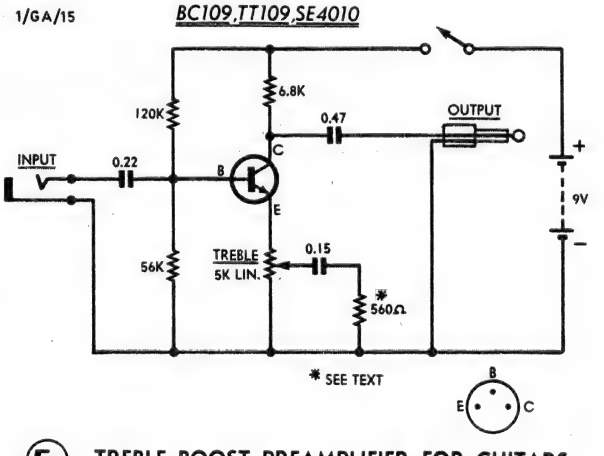
Usually, reduced guitar output can be accommodated by increasing amplifier gain. But a situation will probably arise, perhaps with a borrowed amplifier or new guitar, where the system lacks sufficient treble boost and/or adequate gain with full bass cut. And, inevitably there will be an occasion when a large amount of boost is required for some special effect; more than can be provided by both the amplifier and guitar tone controls together.

Apart from fitting an external treble preamp, which is the topic of this article, it may be possible with some guitar amplifiers to make a slight modification to add a limited amount of treble boost. The technique was used in the Playmaster 117 (60 watt) guitar amplifier described in the July, 1967 issue, and consists of adding a treble pass network to the feedback circuit.

However, we stress that modification to amplifiers should not be made unless the reader is reasonably confident and that, further, only a limited amount of boost may be obtained in this way. In essence, the modification enables the negative feedback to be reduced, via a suitable switch, at treble frequencies, so increasing the amplifier's gain.

In most valve amplifiers the feedback network is fairly simple, consisting of a series resistor from the output-transformer secondary back to a cathode resistor in one of the stages. A simple series RC network to shunt the cathode resistor will then provide the required treble boost. The network in the Playmaster 117 amplifier may be taken as an example of the technique, but suitable values may have to be found on an experimental basis to suit the particular amplifier concerned.

Nevertheless, it would be unwise to aim for more than about 6 or 8dB by this means. As even the better amplifiers do not have any more than about 16db of negative feed-back in the main loop, reductions of more than the suggested amount could result in stability and distortion problems.




*A circuit diagram for the boost preamplifier. Note that the omission of the 560 ohm resistor will provide extra boost making a total of 26dB.*

**TREBLE BOOST PREAMPLIFIER FOR GUITARS**

Just to put all these dBs in perspective, for those who may not be proficient in their use, we most often use them to relate changes in voltage or power to actual loudness changes as heard by the ear. About the smallest perceptible change for a healthy ear is 3dB, any smaller change would not be heard. However, the smallest significant change in sound level is around 6dB; a voltage change of two times, or a power change of four times.

However, it takes a change of 10dB (10 times the power) to produce a subjective impression of "twice as loud". (This is well worth keeping in mind when comparing the power output specifications of various amplifiers.) From this it can be appreciated that the 20dB of boost provided by this treble boost amplifier will produce an audible increase of approximately four times. This is quite a large amount, when compared with a typical domestic amplifier which may provide around to 12 to 16dB available boost at 10KHz.

The externally fitted treble boost preamplifier described here will, as we said, provide 20dB boost at 3KHz with reference to 300Hz. However, with a minor alteration an extra 6dB can be obtained, making the total boost 26dB.

The preamplifier is quite simple in both construction and operation, consisting of a single transistor stage with a facility for adjusting the amount of treble boost. A lead from the guitar plugs into the preamp's input jack, while an output lead from the preamp connects to the guitar amplifier. An on/off switch is incorporated in the boost control for greatest convenience.

Continuous control of treble boost is provided by a 5K linear potentiometer incorporated in the circuit as shown. Its function in providing the large amount of treble is quite simple.

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# the TEMPO Series 2000 modular stereo system

The new TEMPO 2000 Series, designed and manufactured in Australia, incorporates the latest solid state integrated circuit design. The three separate modular units are attractively finished in oiled walnut, and can be arranged to suit any room. Amplifier and record changer/player unit incorporates the new Garrard 2025 TC automatic changer, and can, for those who prefer manual operation, be used as a player. The Garrard 2025 is fitted with a wide range ceramic cartridge and micro-lift for easy track selection. The two loudspeakers are designed to complement the performance of the amplifier unit, and are perfectly matched, both in quality and appearance, to the TEMPO 2000 amplifier.

**DETAILED SPECIFICATION.** Power Output: 8 watts per channel (8 ohm load) IHFM 16 watts total MUSIC POWER. 5 watts per channel (8 ohm load) RMS. Distortion: Total Harmonic distortion less than 1% measured at 5 watts RMS. Frequency Response: 35 Hz to 50 kHz ± 2dB. Damping Factor: 10 at 8 ohms. 20 at 16 ohms. Inputs: Pickup. Tape. Tuner. Sensitivity: All inputs 80 mV for full output. Bass control: Continuously variable, plus/minus 10dB at 100Hz. Treble Control: Continuously variable, plus/minus 10dB at 10 kHz. Balance Control: Zero to maximum either channel. **TUNER SECTION.** Sensitivity: 4 Microvolts. Bandwidth: 8 kHz. Tuning Range: 530-1620 kHz. Antenna: Internal ferrite rod. Ext. ant. provision.

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MC.E10.68

stage gain of only slightly more than unity. However, as the frequency increases the emitter resistance is progressively shunted by an impedance, comprising a 560 ohm resistor and 0.15uf capacitor, to a point at about 3KHz where the gain is 20dB, and limited only by the 560 ohm resistor.

As the bypass tapping point is moved down the resistor, when the potentiometer is rotated, the maximum treble gain is reduced to some intermediate value. Thus, the treble boost effect can be varied over a wide range to meet all situational requirements.

In restricting the maximum gain to 20dB at 3KHz, our aim was to prevent any overload and consequent distortion in the guitar amplifier input stages. However, the chance of overload occurring will depend upon the guitar output and its high frequency harmonic content, and the maximum allowable input to the amplifier.

Depending upon playing technique and position of the guitar pickup heads the output waveform will vary from something essentially sinoidal to one which comprises mainly consonant harmonics. But, the amplitudes of harmonics in the region of 3KHz will be far smaller than the fundamental and lower harmonics. Provided that the amplifier has a reasonable overload margin the 560 ohm resistor could be omitted, thus increasing the treble gain by a further 6dB.

Whether to include the resistor or reduce it in value is a matter for individual decision, depending on the particular requirement and equipment used. Conceivably, the 560 ohm resistor could even be increased if less than 20dB treble gain is required.

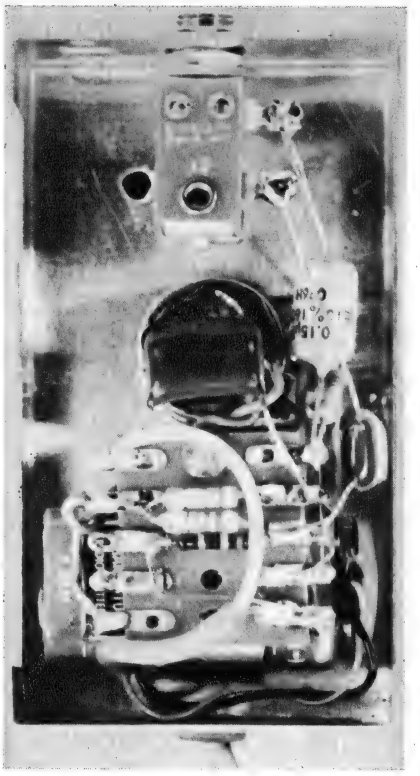
As presented, the preamplifier operates from a 9-volt supply which, for convenience, can be a small battery with press-fit terminals. The supply is switched via a switch on the treble potentiometer but, if the unit is accidentally left on occasionally, it will have little effect on the battery life as the preamp current drain is very modest.

Construction of the preamplifier is very straightforward and should present little difficulty, being similar in many respects to the preamp for electric guitars described in the October, 1968 issue. We built the prototype in the same style of small aluminium box previously used; it measures 4¼ x 2¾ x 1¼in.

The components were wired on a small section of miniature resistor panel mounted over the battery at one end of the box. A bracket fashioned from a small piece of aluminium serves to retain the battery, and connection is made via a standard press-fit connector.

Output from the preamplifier is taken via a length of shielded microphone cable which should be fitted with a connector to suit the amplifier with which it is to be used. The input connection is made via a standard jack-socket, these being most fequently used in guitar hook-ups. The socket was mounted in the end of the box, opposite the wiring board and battery assembly and the potentiometer was mounted centrally between the two.

The housing was then completed by the addition of the lid, which was secured by two self-tapping screws. A knob fitted to the treble control potentiometer and an indicating arrow inscribed with black drawing ink and laquered completes the unit ■



*The input jack (from guitar) is at the top of the picture, the boost control pot in the centre (partly obscured) and the terminal board and battery at the bottom.*

## PARTS LIST

*HARDWARE*

*1 Aluminium box, 4¼ x 2-3/8in x 1¼in.*
*1 9V battery (216) and conector.*
*1 5-lug length of miniature resistor panel.*
*1 Standard jack socket and plug.*
*1 Knob.*

*TRANSISTORS*

*1 TT109, BC109, SE4010 or similar.*

*RESISTORS*

*1 5K linear potentiometer with switch.*
*1 120K, 1 x 56K, 1 x 6.8K, 1 x 560 ohms. (All ¼W 5 pc.)*

*CAPACITORS*

*1 0.47uF low voltage plastic or ceramic.*
*1 0.22uF low voltage plastic.*
*1 0.15uF low voltage plastic.*



## FORUM — continued from page 64

*head). This is due to a different amount of refraction with a different "thickness" of air in the visual path.*

*To provide for this, it is essential to be able to adjust the frequency of the drive oscillator. The facility for adjustment is also handy in adapting to an available reduction ratio for the gearing if the ideal ratio cannot be provided. My own telescope drives slightly fast on 50Hz but, by lowering the frequency slightly, I have been able to get by without having to obtain a different set of gears.*

*Another good point about variable frequency drive is the ability to track the Moon and the planets, all of which move at different rates relative to the observer.*

*Instead of a Wien Bridge, try a UJT pulser feeding a J-K flip-flop, the output of which triggers the gates of a pair of SCRs in a class-D (switching) amplifier. The SCRs could be replaced by an ordinary push-pull amplifier, if that seemed more suitable.*

*The frequency should be variable between 40 and 60Hz. Two push-buttons, one slow, one fast, together with a helipot, for fine adjustment, complete the set-up.*

*No amount of frequency adjustment will move the scope fast enough for setting up in the first place, or for corrections during astro-photography. For this, it is necessary to resort to differentials in the gear train, driven by a high-speed reversible motor. A quick tap on the control button centres the guide star fast.*

*Finally, for those whose interest is simply in the "oohs" and "aahs" of star clusters, etc., a synchronous motor driven from the 50Hz mains is more than accurate enough.*

*(L.B., Belfield, N.S.W.)* ■

## NEAT man—That's the way to enjoy Hi-Fi Music

### CARTRIDGES

**V70 MOVING MAGNET CARTRIDGE.**
*** Review from Hi Fi News available.**
**The V70 is a top performance—high quality magnetic cartridge that out-performs many more expensive cartridges.**

Specifications—Output voltage: 5mV 1,000 c/s 5 cm/sec. Frequency range: 20-20,000 c/s. Channel balance: ± 0.5 db 1,000 c/s. Channel isolation: 30 db 1,000 c/s. Compliance: 5.0 × $10^{-6}$ cm/dyne. D.C. resistance: 800 Ω. Load resistance: 50K Ω. Playing weight: 1.5 gr.-3 gr. Stylus: 0.5 mil diamond.

*V60 Induced Magnet Cartridge.*
Specifications — Output voltage: 4 mV. Freq. range: 5-30,000 c/s. Channel isolation: 30 db. Compliance: 6 x $10^{-6}$ cm/dyne. Stylus: 0.7 mil. diamond. 0.2 x 0.8 mil. for Model V-60E.

*V15 "Dynamagnet" Cartridge.*
Specifications — Output voltage: 5 mV. Freq. range: 20-21,000 cps. Cross talk: 30db at 1,000 cps. Stylus: 0.7 mil. diamond. 0.2 x 0.8 mil. for Model V-15E.

### NEAT TONE ARMS

*G-32 "Gyrostat" Professional Tone Arm.*

**This professional Tone Arm is a beautifully engineered instrument featuring the revolutionary "GYROSTAT" rotary mechanism. Designed for milligram tracking and as for all NEAT tone arms, will accept all standard ½in mounting cartridges, including Ortophon and SME headshells without modification.**

*G-30 Static Balance Tone Arm*
* Review from "GRAMOPHONE" available.

The NEAT G30 Static Balance Tone Arm is a high quality—low priced Hi-Fi tone arm, of which the conception, construction and finish are equal to many tone arms selling at considerably higher prices. When used with the NEAT V70 cartridge, an excellent low cost combination can be obtained.
Other outstanding NEAT tone arms available are the G37 Static balance tone arm, and the G36 Professional tone arm.

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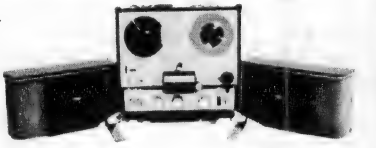
## FEBRUARY SPECIALS



*Sony TC-200B. Vertical or Horizontal Operation.*
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Features • Complete 4 track stereo and mono tape recording and playback system. • Sound on Sound recording. • Two complete full range satellite speaker systems. • Individual VU meter and volume controls for each channel. • Light weight (only 27 lbs.). • Two Sony high quality dynamic microphones. • Compact carry case beautifully styled in black and ivory decor.
**Truscotts price only $190.00.**

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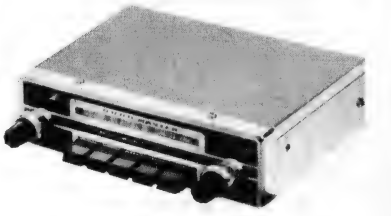

The new super sensitive push button all transistor car radio, featuring 8 trans.—3 W. output—push button tuning—built-in noise suppression—high quality speaker—suit any car—Truscott's price only **$55.00**
If aerial required add **$4.00.**

### COMBINATION SPECIALS FOR FEBRUARY

Kenwood TK 2OU Stereo Amplifier with AM-FM tuners—Dual 1010F Deluxe Turntable with Neat V70 Magnetic Cartridge—2 Kenwood S102U Speaker systems. **$373**
With JH Turntable, Neat G30 Tone Arm and V70 cartridge in lieu of Dual 1010F. **$357**

Kenwood TK 150U Stereo Amplifier—JH Turntable, Neat G30 Tone Arm and Neat V15 Mag. cartridge—2 Kenwood S102U Speaker systems. **$279**

Leak Stereo 30 Amplifier—Dual 1009F Turntable with Neat V15 Mag. cartridge—2 Leak Mini-Sandwich speaker systems. **$464**

With Dual 1015F Turntable and V15 cartridge in lieu of 1009F. **$451**

Kenwood TK 250U Stereo Amplifier—Dual 1019 Turntable with Neat V60 Mag. cartridge—2 Kenwood KL60 Speaker systems. **$565**

With Dual 1009F Turntable and V60 cartridge in lieu of 1019. **$536**

### NEAT HI-FI EQUIPMENT

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# A READER BUILT IT!

***Circuits and devices which we have not actually tested in our laboratory but published for the general interest of beginners and experimenters.***

## EHT generator with standby switch, "volume" control

**Mr B. M. Byrne, 118 Central Avenue, Indooroopilly, Qld. 4068, has amended the circuit of the E.H.T. Generator (published in "Electronics Australia," January, 1968) to provide an additional facility.**

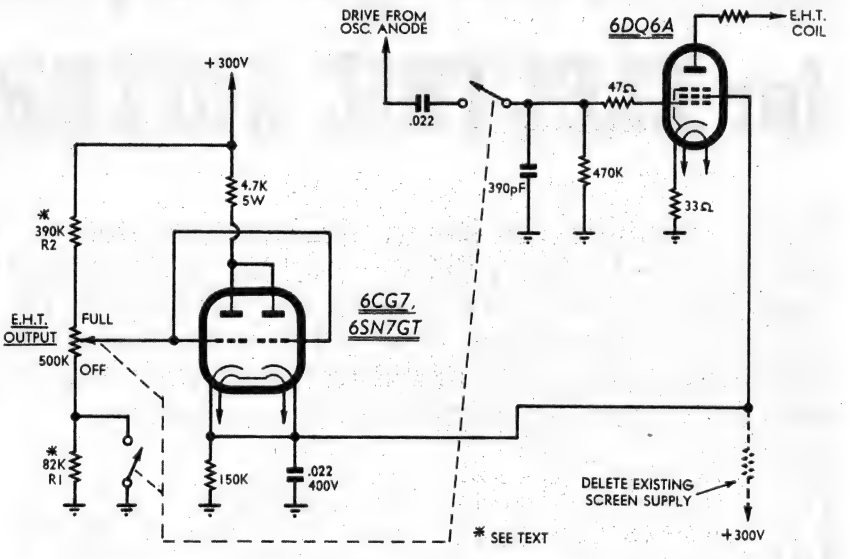
Having made the E.H.T. Generator I found it filled a useful slot not covered by any other item. However, one need was a standby switch to allow connections to be made, preferably without allowing the tubes to cool. Then, if a standby switch had to be mounted, why not include a "volume" control? The need for a variable output is not adequately met by the frequency shift control on the oscillator. Certainly this allows the output to be peaked, but the facility for sweeping the voltage up from a relatively low figure to full output is not available. Gas tubes and electrometer devices are more interesting if this range of voltage is available.

The problem, then, was how? As the 6DQ6A has appreciable power delivered to its control grid, it is not possible to achieve a linear sweep with an input pot. The pot. would be in trouble from power dissipation as it neared the full-on position and the grid bias would disappear from the valve as the drive was removed.

Manipulating the cathode circuit presents its own problems, while the anode circuit is loaded with energy—so the only remaining electrode is the screen grid. To provide a reasonably smooth sweep and to cater for screen current requirements, a rather massive (and expensive) pot, about 10K 20W, would be required. Still, the screen seemed the logical electrode to work on. A light current (10mA) controlled supply seemed a reasonable prospect: the amended circuit was tried and found to work.

A 6CG7 (a 6SN7 would do) is used as a series feed to the screen — in effect a DC cathode follower. This valve has a fairly healthy heater/cathode voltage rating, and has generally suitable characteristics. A switch-pot. provides the control, with R2 limiting the maximum output voltage to the 6DQ6A screen. About 180V sees the 6DQ6A just about "flat out." If the HT voltage is lower than the nominal 300V, a lesser value of R2 would be fitted to achieve 180V as the screen maximum voltage.

At the no-output end of the pot. it is necessary to wire in a switch (part of the switch-pot) to break the drive to the 6DQ6A to prevent some relatively small output appearing at the anode. Removal of the drive does not cause excessive anode current, as the screen is at earth potential at this end of the pot. rotation.




The other switch pole on the pot serves to remove the short from R1 when it is switched to no output. This puts a small DC potential on the control valve grid and a few volts on the 6DQ6A screen, to draw about 60mA standby current. In the absence of this provision, the HT rises to a value that, if maintained, may damage the filter electrolytics or exceed valve ratings, especially if a high voltage power transformer is used. The value of R1 should be chosen to produce 2V at the cathode of the 6DQ6A in the "off" mode.

## Broadcast-band aerial for the Outback

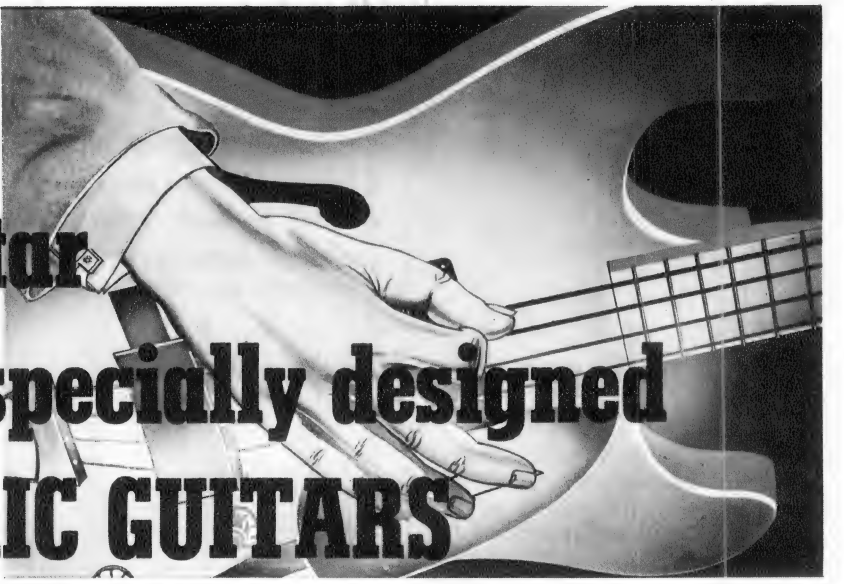
**Mr J. M. Wheller, 29 Budwood Terrace, Auchenflower, Qld. 4066, submits an idea for an aerial to help country listeners improve their broadcast band reception.**

People in outback parts suffer greatly from skywave interference from unwanted stations, which sometimes jam their local or nearest station. The writer constructed a 3ft x 3ft frame aerial from some scraps of pine, wound three turns on it and tuned it with a .0003uF capacitor. Both top and bottom horizontal sections were wrapped in cigarette carton foil (quite a good conductor) and tied together. The frame is suspended from some timber bridging two steel bars used on an open sundeck, the aerial being below and to the north of the adjacent roof. The aerial cost 30c.

The aerial gives reception within a dB or so across the broadcast band. By altering the azimuth and bearing, unwanted stations can be eliminated. Where stations are sharing a frequency with an unpleasant beat, one can be selected by adjusting the aerial. To give some idea of its discrimination, it was able to reject nearby 4QR with 50kW on 590KHz and bring in Hobart with 10KW on 600KHz.

Another 6ft x 7ft aerial is currently under test, but not yet tuned. It is sharp as a razor on the null and excellent for azimuth adjustment. With this aerial, I have received stations as far away as 6WA. A small battery receiver is being used pending the completion of a mains receiver.

Another suggestion is for a group of neighbours to erect two 30ft posts with wire strung between to form a larger frame. The bottom corners should be capable of being adjusted for azimuth.

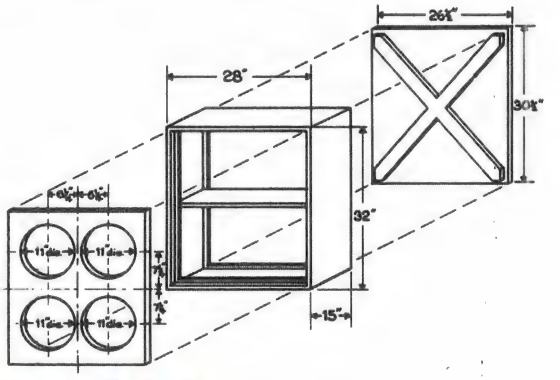


# A Bass Guitar Enclosure specially designed for ELECTRIC GUITARS

Built to handle the severe stresses imposed by the sounds from a bass guitar, this highly reliable unit has been designed to satisfy the rugged requirements of 60 watts of deep, rich sound. The enclosure contains four 12″ Hi-Flux speakers, type 12PQ with Alnico ring magnetic systems for maximum sensitivity and durability. Low resonance and controlled excursion make for the utmost in bass response.

**SPECIFICATION**

| TYPE NUMBER | 50226/12PQ/15 PRESTIGE FINISH | 21622/12PQ/15 MANUFACTURERS TYPE | 53416/12PQ/8 MANUFACTURERS TYPE |
|---|---|---|---|
| Impedance | 15 ohms | 15 ohms | 8 ohms |
| Frequency Range | 35-6000 Hzs | 35-6000 Hzs | 35-6000 Hzs |
| Resonance | 40 Hz | 40 Hz | 40 Hz |
| Maximum Power Handling | 15 W | 15 W | 15 W |
| Magnet Material | Alnico V | Alnico V | Alnico V |
| Flux Density | 10500 gauss | 10500 gauss | 10500 gauss |
| Total Flux | 82000 lines | 82000 lines | 82000 lines |
| V.C. Diameter | 1¾″ | 1¾″ | 1¾″ |
| Mounting Hole Centres | 11¾″ P.C.D. | 11¾″ P.C.D. | 11¾″ P.C.D. |
| Maximum Depth | 6¾″ | 6¼″ | 6¼″ |




**MANUFACTURERS SPECIAL PRODUCTS PTY. LTD.**
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MSP Hi-Flux SPEAKERS

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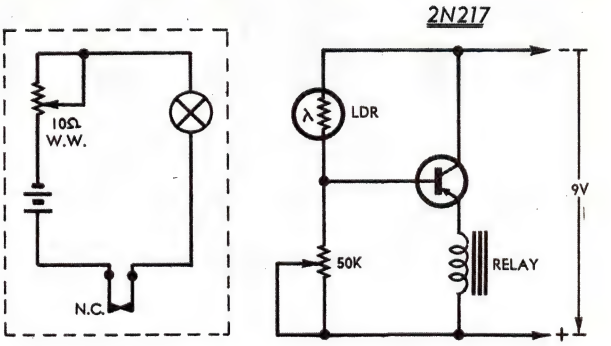
**SYDNEY:** Electronic Parts Pty. Ltd. 533 1277.
George Brown & Co. Pty. Ltd. 29 7031.

# A LIGHT-CONTROLLED RELAY WITH FLASHER CIRCUIT

**A circuit for a light controlled relay which could be used in a number of applications has been submitted by a reader who wishes to remain anonymous.**




This light controlled relay can be used for many things, depending on the builder's ingenuity, such as for an alarm, remote operation of a garage door using car light, etc. I built a little add-on unit to make it function as a flasher unit.

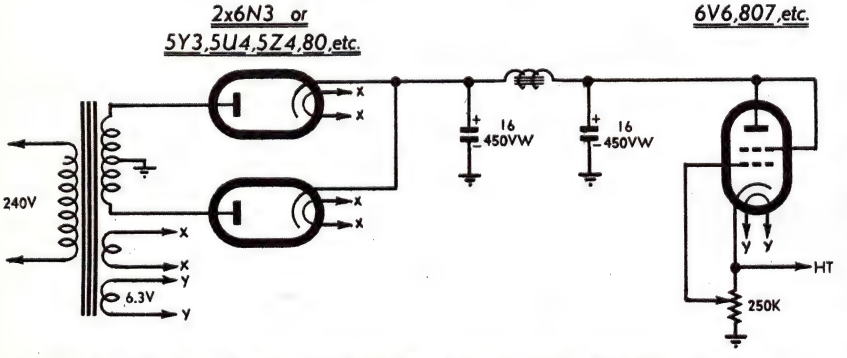
The light dependent resistor is any readily available type with a resistance of about 680 ohms when exposed to light. I used a 2N217 transistor because this was a type I had on hand, but an OC71 or AC128 should work just as well.

The lamp and light dependent resistor are bound together by tape to keep out external light. The light from the lamp causes the LDR to drop in resistance. This alters the bias conditions of the transistor and operates the relay, turning off the lamp. The LDR resistance rises, the relay drops out and the light goes on again, and so on.

Another lamp can be connected in circuit using another pair of contacts to give a flashing light effect. The variable resistor of 5-10 ohms was added to lower the brilliance of the lamp and reduce the rate of flashing. (K. R., Henley Beach, S.A.)

EDITOR'S NOTE: In some cases where low sensitivity can be tolerated it may be possible to omit the transistor.

# A SIMPLE VARIABLE HT POWER SUPPLY




**Mr M. Taylor, 9 Beaconsfield Road, Mortdale, N.S.W. 2223, submits a circuit for a simple variable HT supply. In one form or another it could be built around almost any set of power supply components.**

I have enclosed the circuit of a universal power supply for the "Reader Built It" section. It should be useful to many experimenters and many of the parts can be obtained from the "junk box," making it cheap to build.

The circuit is simple and has a HT voltage range of about 55 to 385 volts, depending on the transformer used. This item can be taken from an old radio, and a filter choke may be available from the same source. However, in the interest of safety it would be wise to use new electrolytic capacitors. Do not earth the 5 volt filament winding on the transformer.

No meters are required as the system has fairly good regulation. Potentiometer R1 may be calibrated directly in volts for a reasonably accurate approximation.

(Editorial Note: Normal voltage and current limits must be observed for the control valve. Notably, the voltage developed across the valve, with the HT set to a low figure, should not exceed the manufacturer's ratings. Similarly, the current through the valve under heavy load conditions should not exceed these ratings.)

# TESTING TRANSISTORS

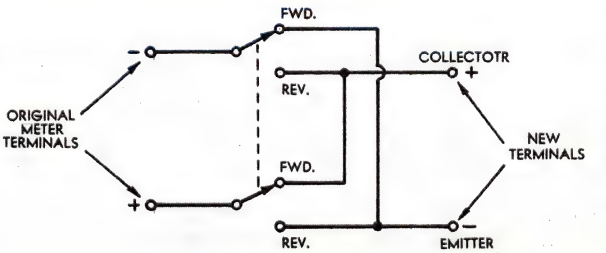
**A reader, who wishes to remain anonymous, has submitted an idea as a follow-up to the article on testing transistors with a multimeter which appeared in "Electronics Australia" in November, 1968.**

Experimenters and servicemen may wish to make the following addition to their volt-ohm meter in order to adapt it for convenient testing of bipolar transistors. It comprises nothing more than a changeover switch and a new pair of terminals, and may be made a permanent installation in or on the meter.

"On my meter I have mounted the adaptor on a board so that it both contacts and is clamped to the meter by the existing terminals. The new terminals are marked +VE (collector) and —VE (emitter), and the changeover switch FWD (forward)/PNP and REV (reverse)/NPN. The changeover switch is rated at 1000V and 10A, to protect myself while using the meter for other purposes. For good measure it was thickly covered with silicon varnish after wiring.

"To test transistors (with the meter switched to a low voltage, low current resistance range) I connect the +VE lead to the collector, the —VE lead to the emitter, and hold the collector and base of the transistor therby providing skin resistance between collector and base. I move the changeover switch until I get a meter reading. An increase in pressure on the collector and base alters the bias and gives a variation in meter reading. This immediately establishes both the polarity and presence of amplification. (B.L.H., Elizabeth South, S.A.).

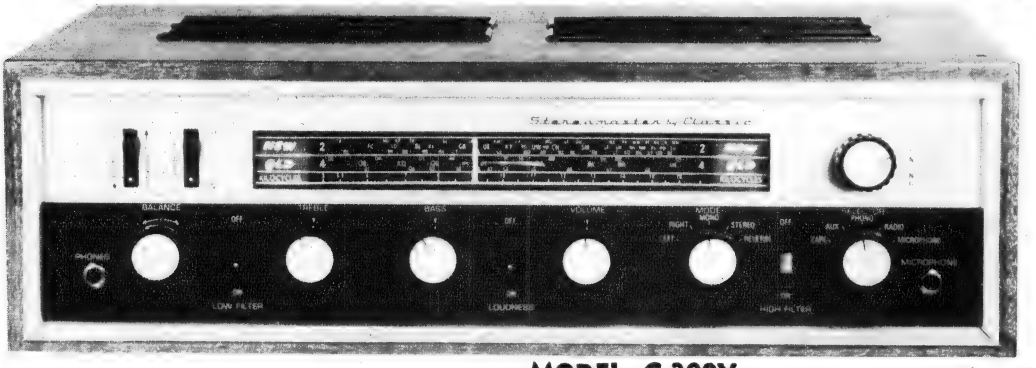
**Editorial note:** When testing transistors and diodes with a multimeter or ohmmeter certain precautions must be taken if the testing is to be valid and if risk of device damage is to be eliminated. For further information regarding such precautions, readers should refer to the November, 1968, article. ■



# NEW *Releases!*

## IN HI-FI STEREO EQUIPMENT BY CLASSIC

## BASED ON THE PLAYMASTER 118 AMPLIFIER



**$128.00**

FREIGHT EXTRA

Dimensions 16½" x 5½" x 11

**MODEL C 300V**

This amplifier is based on the Playmaster 118 circuit as featured in "Electronics Australia" to which has been added the following features.

- Inbuilt high gain A.M. tuner with a coverage of 530 to 1,600 K.C.
- Loudness control giving bass boost at low volume.
- High and low filters (scratch and rumble filters).
- Provision for tape, record and play-back, with din connector.
- Provision for headphones with headphones-speaker switch.
- Input for microphone with jack on front panel.
- Calibrated dial available for all States.
- EM84 tuning indicator giving accurate tuning with ease.

POWER OUTPUT: 9 watts per channel R.M.S. FREQUENCY RESPONSE: 20 to 20,000 cycles incorporating Ferguson O.P.412 grain oriented output transformers. VALVES USED: 4-6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2 silicon diodes.

**CABINET IN OILED WALNUT OR TEAK WITH METAL TRIM.**

(Cabinet and front panel of valve and transistor amplifiers with tuner are the same)

---

## MODEL C200V. BASED ON THE PLAYMASTER 118 WITH TUNER

Specifications as C300V but less high and low filters, headphone and microphone jacks.

Dimensions 16½in x 5½in x 11in.

CABINET IN OILED WALNUT OR TEAK WITH METAL TRIM.

**$118.00** FREIGHT EXTRA

---

## NEW AMPLIFIER AND TUNER BASED ON THE PLAYMASTER 107

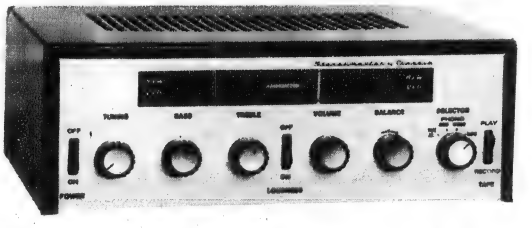
**107 AMPLIFIER AND TUNER**

**$85.00**

***FREIGHT EXTRA***

**107 AMPLIFIER**

- Output 5 watts per channel (10 watts). Ferguson output transformers with a response of 30 to 20,000 cycles.
- Valves used: 6AN7, 6N8, 2—12AT7, 2—6BQ5, and 6CA4 rectifier.



**SPECIFICATIONS**

- Inbuilt high-gain tuner with a frequency coverage of 530 to 1,600KC.
- Two-channel tone control stage with separate bass and treble controls.
- Switching facilities for pick-up and stereo or mono tape recorder for record or play-back.
- Loudness control giving bass boost at low volume.
- Chassis plated and mounted in attractive metal case finished in grey with control panel in silver and black with matching knobs and switches.
- Dimensions: 13½in x 5¼in x 11in.
- Fully guaranteed.

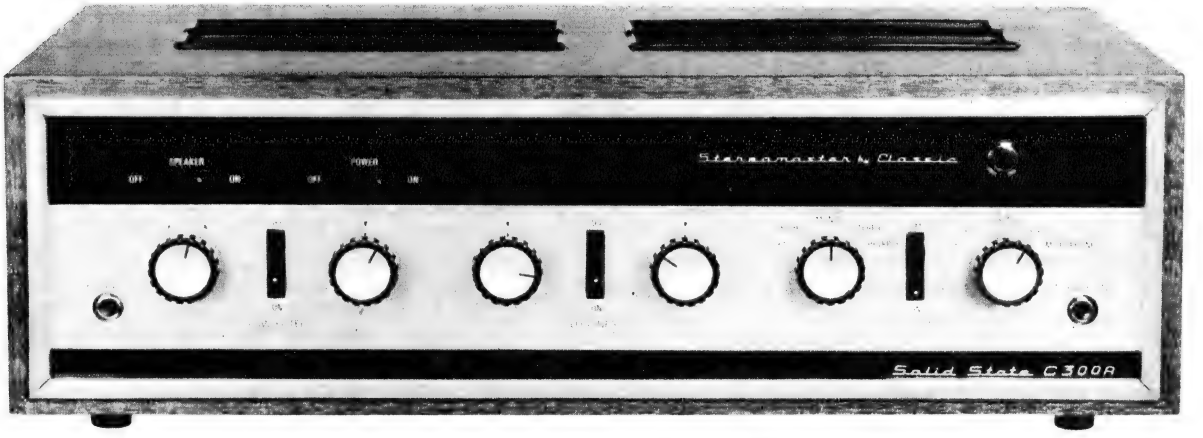
***The above amplifier supplied with the new Garrard 40 Mk II Changer with Sonatone ceramic cartridge and diamond stylus and two Magnavox 8WR or Rola 8CMX Hi-Fi speakers.***

**$132.00 FREIGHT EXTRA**

# CLASSIC RADIO

**245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145**

# NEW ALL TRANSISTOR STEREO AMPLIFIER
# ULTIMATE IN DESIGN-LONG DEPENDABILITY
## USING ALL SILICON TRANSISTORS




**MODEL C 500A**

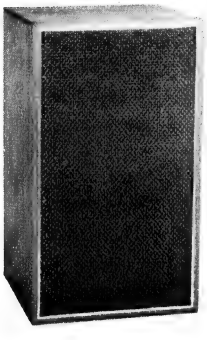
**$110.00 FREIGHT EXTRA**

**SPECIFICATIONS**

POWER OUTPUT: 12 watts per channel R.M.S. (24 watts total).
FREQUENCY RESPONSE: From 20 cycles to 20,000 cycles ± 1dB.
HARMONIC DISTORTION: Less than 1%.
HUM AND NOISE: Aux. 70dB, Mag. 50dB.
INPUT SENSITIVITY: Mag. 3mv. Aux. 150mv. Tuner 150mv.
EQUALIZED: Mag. RIAA.
TONE CONTROL: Bass 50c/s ± 12dB. Treble 10kc/s ± 12dB.
LOUDNESS CONTROL: 50c/s 10dB.
SCRATCH FILTER: (High filter) at 10kc.s 9dB.
RUMBLE FILTER: (Low filter) at 50c/s 5dB.
PROVISION FOR TAPE RECORDER. RECORD OR PLAY BACK WITH DIN PLUG CONNECTION.
PROVISION FOR HEADPHONES WITH SPEAKER — HEADPHONE SWITCH.
INPUT FOR MICROPHONE WITH JACK ON FRONT PANEL.
THE CIRCUIT CONTAINS 24 SILICON TRANSISTORS PLUS 4 DIODES.
MOUNTED IN OILED WALNUT OR TEAK CABINET WITH METAL TRIM.
DIMENSIONS: 16½in x 5½in x 11in.

## C300 AMPLIFIER WITH INBUILT TUNER

The above amplifier can be supplied with an inbuilt A.M. tuner as illustrated on opposite page, with dial scale available for all States. **$130.00 FREIGHT EXTRA**



**MULLARD MAGNAVOX MINI SPEAKERS**

These units designed by Mullard and Magnavox engineers compare favourably with imported B/S Speakers costing more than twice the amount and are ideal where space is limited. Incorporates the Magnavox 6WR 6-inch Speaker and the new 3TC Mk. II tweeter frequency response, 50 to 18,000 cycles. Power rating max. 8 watts. **Available in 7½ or 15-ohm impedance.**

Dimensions: 14in x 8¼in x 8¼in.

**$27.00**

Post and Packing: N.S.W. $1.50. Interstate, $2.00.

## NEW BOOKSHELF SPEAKER SYSTEMS

**PLAYMASTER .4**

Incorporates the new 6in Philips Speaker and Magnavox 3TC tweeter. Frequency response 45 to 18,000 cycles. Power rating 10 watts. Dimensions. 14in x 8in x 8in.

**Available in 8 ohms only.**

**$36.00**

Post and Packing: N.S.W. $1.50. Interstate, $2.00.

**PLAYMASTER SUPER BOOKSHELF**

Using two of the new Magnavox 6WR Speakers and one 3TC tweeter. Dimensions: 19½in x 10in x 8in.

**Available in 15 ohms or 8 ohms.**

**$40.00**

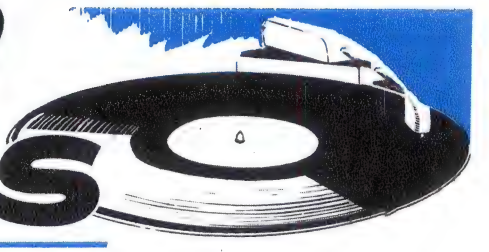
Post and Packing: N.S.W. $2.00 Interstate: $3.00.

*ALL SPEAKER UNITS FINISHED IN OILED WALNUT OR TEAK WITH SILVER TRIM*

# CLASSIC RADIO

**245 PARRAMATTA ROAD, HABERFIELD, N.S.W. PHONE 798-7145**

# AUDIO TOPICS



# PHASING STEREO LOUDSPEAKER SYSTEMS

One of the important requirements in a stereo amplifier system is that the loudspeakers should operate in phase with each other. This can be ensured by paying proper attention to the connections and the wiring. It can be double-checked by a simple test.

By W. N. Williams

There is nothing very mysterious about the term "in phase," as applied to loudspeakers in a hi-fi system. It means that, if fed with an identical signal, all cones in the system would move in the same direction — either towards the listener or away from the listener. (See figure 1.)

In a six-loudspeaker system, with a high-frequency "tweeter," mid-range and low frequency "woofer" unit for each channel, there will be six cones in phase. With a four-loudspeaker system, there will be four cone assemblies in phase and, with a two loudspeaker system, there will be two.

The situation depicted in figure 1 can be defined as the normal one for a stereo system, on the assumption that the original sound image will be re-created most accurately when the loudspeakers are arranged in two compact groups, operating in phase, directed towards the listening area, and with the groups separated by a distance appropriate to the dimensions of the room.

To be strictly practical, the phase relationship of a high frequency tweeter to the mid- and low-range units, or to its counterpart in the other channel, is not as critical as the foregoing paragraph might suggest. This is due partly to the fact that separate tweeters must, of necessity be separated from other loudspeakers by a distance which is significant in terms of the wavelength of the sound being propagated; how the wavefronts interact is as much a matter of cone location as of cone phasing. In addition, what the listener hears is greatly modified by random reflections from the walls, floor and ceiling of the listening room.

Appreciating this fact, some system designers deliberately point tweeter loudspeakers upwards on the basis that high frequency sound dispersed (or bounced) from wall/ceiling corners is more acceptable than that beamed directly at the listeners. Strangely, however, such designers usually pay lip service to phasing by seeing to it that tweeter cones move outwards in their housing at the same instant that other cones in the system are doing likewise!

With loudspeakers handling the mid-range of frequencies — say 400 to 4000Hz — reflections can still disguise the effect of in-phase or out-of-phase operation to some extent. It is nevertheless reasonable to set down, as a positive requirement, that mid-range loudspeakers should operate in phase with their associated woofer and with their opposite channel counterparts in a stereo system.

There can be no equivocation, however, on the fact that the cones producing the low frequencies in each stereo channel be in phase with each other. While there may be a considerable difference between the middle- and high-frequency content of a pair of stereo signals, the low frequency components in the two channels may be quite similar in amplitude and phase. Particularly is this likely to be so in recordings which have been made using a single stereo microphone or for compatible stereo/mono playing. In the case of mono records played on a stereo system, the content will, of course, be the same.

In all these cases it is essential that the cones handling the low frequencies co-operate in the effort to move air towards or away from the listener on the respective half-cycles.

If the bass cones move out of phase, they will tend to pump air back and forth in the space between them instead of propagating the sound out into the listening room. (Figure 2). The apparent effect, upon the listener is that the system lacks bass response.

Many of the uncertainties about loudspeaker phasing arise from the fact that enthusiasts often do not start to worry about it until the systems are virtually ready to go. The loudspeakers are installed in an enclosure, wired up and linked to a couple of unmarked connectors on the back. Non-coded wires are used for the run back to the amplifier and only then — if he is aware of the requirement at all — does the enthusiast pause to wonder about whether or not the loudspeakers will operate in phase.

Uncertainties about phasing can largely be obviated by taking appropri-

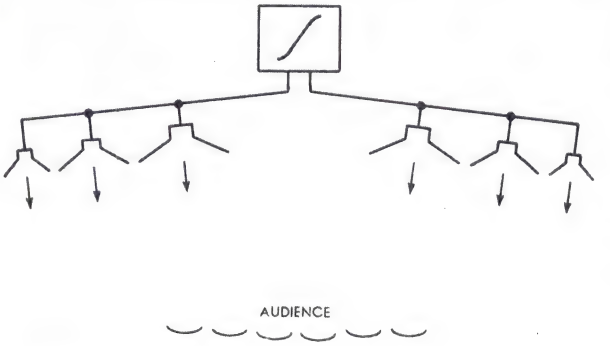



*Figure 1: Loudspeakers are said to be connected in phase if their cones move in the same direction when the voice coils are fed with a common signal.*

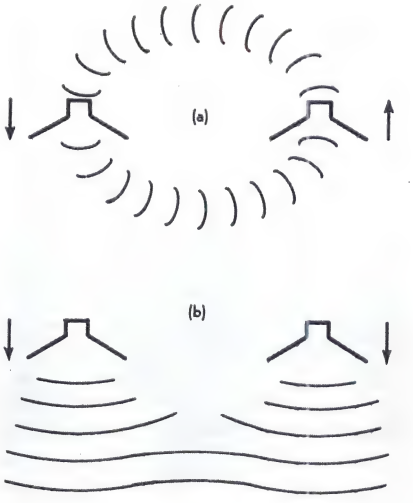



*Figure 2: When the low frequency cones in a stereo system operate out of phase (a) they circulate the air in the space between them. In phase (b) the energy is propagated into the room.*

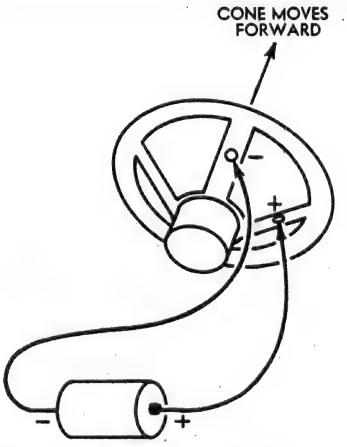



*Figure 3: Observe which way round a 1.5V cell has to be connected to a loudspeaker to cause its cone to move forward in the housing. Mark the voice coil connections to correspond.*

ate measures at the time a system is being set up.

The first requirement is an ordinary 1.5V torch cell, a pair of clip leads and a pair of eyes. Try touching the cell across the voice coil terminals and note the connection which causes the cone to move forward in its housing when the contact is made. Having discovered the appropriate connection, mark the loudspeaker with the same polarity as the battery — plus and minus. (Figure 3.)

In many modern loudspeakers, the polarity will already be marked but with the risk, with some imported loudspeakers, that the opposite convention will have been followed. By checking and marking each individual loudspeaker yourself, any worries on this score can be avoided.

Having marked the polarity of all loudspeakers, combinations involved for each channel (woofer, mid-range, tweeter) can be interconnected using two differently coloured wires. The idea is to assume that one side of the input will be "earthy" and will normally go to the "negative" of each loudspeaker in the group. The other or "active" wire, will go to the positive lug(s), either directly, or through series inductor(s) and/or series capacitor(s) where these are called for.

Having thus interconnected the loudspeakers, polarised twin lead can be brought out and run back to the amplifier with one specific colour being selected to represent the "positive" or "active" input to each loudspeaker system.

The next step is to examine the loudspeaker connections to the stereo amplifier. Usually, these will be distinguished in some way. They may be lugs with earth or positive signs, coloured terminals or a polarised plug and socket.

If they are completely unmarked, it may be necessary to examine the circuit and the wiring to establish how the terminals relate to it. In a valve type amplifier, one side of the output transformer secondary will normally be connected to the chassis and this can be marked arbitrarily "earth"; the other will be "positive." In a transistor amplifier the output circuits may connect more directly to the transistors

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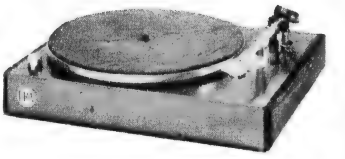
## ERA *The most advanced turntable*

★ The ERA arm outperforms even the most recent cartridge: it can track at 1/10th of a gram.
★ By principle its pivot eliminates all frictions. The pivot is in fact the intersection of four counter-balanced spring blades. They form two X's which do not touch each other.
★ The tracking weight is applied directly to the pivot by changing the angle of the blades. In this way the inertia of the arm is not increased with the tracking force as in all other arms. The pickups sound better.
★ The arm itself is made of a light alloy H beam which eliminates the resonant frequencies of tubes.
★ 33-45 r.p.m., stop between speeds ★ Hydraulic arm lift ★ Total wow and flutter 0.04% ★ Slide in head for all pickups ★ 12 pounds ★ 50 or 60 cycles ★ Power requirement 1.6 watts ★ 22 cms arm ★ The motor of the ERA turntable rotates so regularly that it does not need a heavy platter. It is belt driven to avoid flat spots ★ The ERA motor s synchronous. Its speed is rigorously stable because it is keyed to the frequency of the AC current ★ The oversized ERA motor allows fast starts. It performs excellently under any condition. Laboratory tests proved it could drive a 30 pound weight ★ As in all professional turntables the drive is through a belt. It is made of special neoprene and ground to its specifications within 0.002 of an inch. The simplicity of this one-step drive eliminates wow and flutter.

SUPERIOR SUSPENSION: While listening to a record, hit vertically the turntable with your knuckles: the arm does not jump one groove.

**Made in France. Sole Agents for Australia: Recorded Music Salon.**



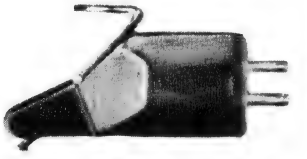
# EMPIRE 888VE Cartridge

**Technical Specifications:**
Frequency response: from 6-32,000 Hz.
Output Voltage: 8.0 mv. per channel.
Channel separation: More than 30db.
Terminating Impedance: 47,000 ohms.

Stylus Replacement: S888VE/ERD Pink.
Compliance: 30 x 10-six cm/dyne.
Tracking Force: ½ to 2 grams.
Stylus: .2 x .7 mil bi-radial elliptical hand-polished diamond.

**Empire quality in a compact system . . .**
**MODEL 2000**
**Technical Specifications:**
Frequency response: 30 to 18,000 Hz.
Components: 10-inch high-compliance woofer with 2in voice coil ★ Mid-range/tweeter direct radiator.

Controls: 3-position treble response switch radiator.
Minimum Power Requirement: 20 watt.
Maximum Power Handling Capacity: 60 watts undistorted.
Impedance: 8 ohms.



**WORLD'S MOST PERFECT MONO/STEREO CARTRIDGE 999VE.**

**Technical Specifications:**
Frequency response: 6 to 35,000 Hz.
Output voltage: 5 millivolts per channel.
Channel Separation: More than 30 db.
Load Impedance: 47,000 ohms.
Weight: 7 grams.

Compliance: 30 x 10-six cm-dyne.
Tracking Angle: 15 deg.
Tracking force: .5 to 1.5 grams.
Stylus: .2 x .7 mil elliptical diamond.
Terminals: 4.
Mounting: Standard 7/16 or ½in centres.

**Made in U.S.A. Sole Agents for Australia: Recorded Music Salon.**

Summary of a technical review in November edition of "The Gramophone" Magazine . . . "the 999VE cartridge is one of the best we have tested and we unhesitatingly put it in the top echelon. It can confidently be recommended to those who want the best irrespective of price."

## The new Armstrong fully transistorised integrated tuner/amplifiers AM/FM and stereo amplifiers. Models 426, 421 and 423.

## SPECIFICATIONS series 400

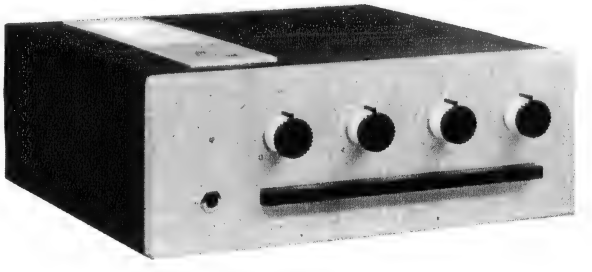
### AMPLIFIER AND CONTROL UNIT SECTIONS 421, 425, 426

| | |
|---|---|
| RMS Power Output | 15 watts per channel, 4–16 ohms |
| Music Power (IHFM) | 20 watts per channel, 4–16 ohms |
| Power Response | 15 watts RMS, 20–20,000 Hz −1 dB. |
| Frequency Response | 20–20,000 Hz±1 dB |
| Harmonic Distortion | Less than 0.5% at 1 kHz measured at 15 watts output±1 dB |
| Crosstalk | Better than 40 dB |
| Channel Matching | ±1 dB |
| Bass Control | ±10 dB at 70 Hz |
| Treble Control | ±10 dB at 10 kHz |
| Balance Control | Maximum to zero each channel |
| Rumble Filter | −5 dB at 30 Hz increasing at lower frequencies |
| Treble Filters | 1. 6.5 kHz−3 dB, 10 kHz−25 dB<br>2. 4.5 kHz−3 dB, 9 kHz−40dB |
| Loudness | At 1 kHz reference (−20 dB), 70 Hz+10 dB, 10 kHz+5 dB |
| Tape Recording Output | 400 mV Low impedance |
| Headphone Output | Suitable for all stereo phones |

| Inputs | Sensitivity | Hum & Noise (reference 15W) |
|---|---|---|
| Tape Playback | 400 mV | −70 dB |
| Radio (421 only) | 100 mV | −60 dB |
| Pickup 1. Ceramic | 60 mV | −55 dB |
| Pickup 2. Magnetic | 3.5 mV | −55 dB |

### AM TUNER SECTION 423, 426

| | |
|---|---|
| Coverage | Medium waveband 185–590 metres; 510–1,625 kHz<br>Long waveband 1,000–2,000 metres; 150–300 kHz |
| Sensitivity | 5 μV for 20 dB quieting |
| Intermediate Frequency | 430 kHz |
| IF Bandwidth | 4 kHz at 6 dB down |
| IF Rejection | 80 dB |



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and it will be necessary to identify the equivalent connections in each channel.

In the latter case — or in either case — the nomination of particular terminal connections as active or positive may be quite arbitrary, provided the SAME convention is applied to BOTH amplifier channels.

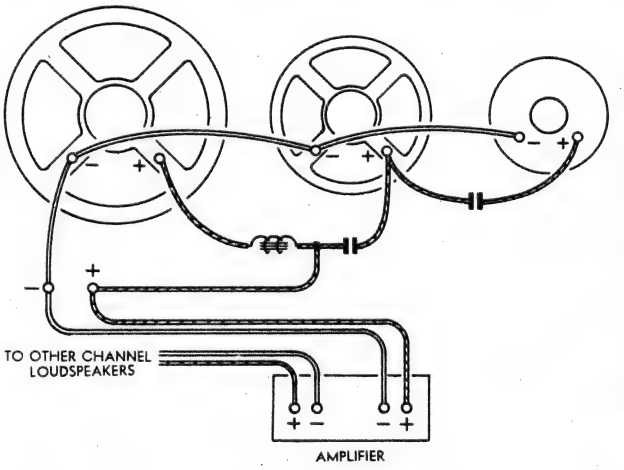


*Figure 4: Having marked the polarity of all loudspeakers as per figure 3, they can be connected in phase in each system and wired back to the amplifier by colour-coded leads.*

Either way, whether the connections are clearly marked, or have to be traced out, the requirement is that the two colour-coded loudspeaker leads be identically connected to the two output channels, the leads going to the equivalent places in the respective output circuits.

In normal stereo amplifier systems, the two channels are identical and, if pre-phased loudspeakers are connected to them symmetrically by colour-coded leads, it is a virtual certainty that the loudspeakers will operate in phase when the system is fed from a mono source, such as a radio tuner, mono tape recorder, or pickup cartridge paralleled for mono operation.

The remaining requirement is to ensure that properly phased signals reach the amplifier from a stereo cartridge. Most modern stereo cartridges have four output lugs which can be identified by markings or by manufacturer's data as left channel active and earth, and right channel active and earth. Sometimes the two "earth" pins are already interconnected and/or bridged to the cartridge case. It is simply a matter of checking through the pickup wiring and connectors to ensure that the two "actives" go to the two active input connections of the two amplifier chains and that the "earths" connect to the appropriate earth returns.

Provided that these precautions are taken, it is almost inevitable that the sound emanating from the respective loudspeaker systems will have the correct phase relationship.

But you still aren't quite convinced? You would like to verify the inevitable.

Well there's an easy way of doing so, at least for those whose loudspeakers are mobile.

Take the loudspeaker systems and place them almost face to face, forming a narrow V, with the top of the V towards the listening position. Leave the system set up to play stereo, but put on a mono disc. Select a track that you know well and set the volume so that it is about the level you like to listen to. The treble may be down a little because of the strange orientation of the loudspeakers, but it should sound acceptable enough.

Listen carefully so that you will remember the tone and volume, leaving the controls set. Switch off and reverse the leads to one loudspeaker system only, switch on again and play the same track. There will be a noticeable difference in volume and bass response. Assuming that the original phasing was correct the sound should now be much lower and noticeably lacking in bass because, instead of combining to propagate the sound out the open V, the cones will be merely pushing the sound back and forth across the intervening space. If the original phasing was wrong, the new condition should be a marked improvement in volume and bass response.

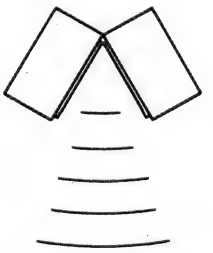

*Figure 5: The phasing of loudspeaker systems can be checked by placing them face to face and changing one set of leads only. The in-phase connection produces louder sounds than the out-of-phase connection.*

Select the condition which gives the fullest sound — the original connection if the phasing instructions have worked out!

A similar test with a radio or other mono input should produce the same result and confirm that the system is correctly phased for all signal inputs.

Incidentally, the "Stereo-Reverse" position on the function switch of many amplifiers does not affect phase; it simply switches the signal belonging to the right channel to the left, and vice versa. Just a few amplifiers have been fitted with a phase reversing switch, usually on the back, to change the phase to one loudspeaker. This should be very carefully examined and marked so that its "normal" position is known. If it is not so marked it can be a constant source of confusion — and a constant temptation to "experiment."

Where loudspeaker systems are not mobile, the problem of verifying phase is more difficult, being rendered the more so in a room which is naturally "live" or in which multiple echoes are created by clusters of hard furniture, passages, etc.

Perhaps the best test is a voice from a mono source, or simple easily recognisable sound effects. Listen critically to the sound, then swap one pair of leads over only and listen again. Theoretically, at least, the in-phase connection should provide the more definite sound image, midway between the loudspeakers.

Some special test and demonstration records contain tracks which are intended to assist the listener in verifying phase, how to use the tracks being the subject of an appropriate instruction on the jacket. However, all these tests rely heavily on listener perception and can be clouded by room acoustics.

Which brings us back to the original point of this article. The best way to cope with phasing is to start out with a battery, a marking pencil, polarised connectors and colour coded wiring and to beat the problem by eliminating it! ■

# Classical reviews

By JULIAN RUSSELL

## Milord — "first rate comic opera"

**HENZE—Der Junge Lord (The Young Milord). Complete Opera. Barry McDaniel (Secretary); Loren Driscoll (Lord Barratt); Vera Little (Begonia); Manfred Rohrl (Burgermeister); Ivan Sardi (Hasentreffer); Ernst Krukowski (Scharf); Helmut Krebs (Professor von Mucker); Patricia Johnson (Baroness Grunwiesel); Ruth Hesse (Frau von Hufnagel); Lisa Otto (Frau Hasentreffer); Edith Mathis (Luise); Bella Jasper (Ida); Sir Edgar (mute). Chorus and Orchestra of the German Opera, Berlin, with the Schoneberger Boys' Choir conducted by Christoph von Dohnanyi. DGG Stereo 139257/59.**

First rate comic operas are rare. Mozart's "Marriage of Figaro," Rossini's "Barber of Seville," Verdi's "Falstaff," Puccini's "Gianni Schicchi" come immediately to mind as peerless examples of the form, with Ravel's unjustly neglected "L'Heure Espagnole," well remembered by anyone who has seen, or even just heard it. I also enjoyed vastly Othmar Schoeck's "The Fisherman and his Wife" which I saw in Hamburg in 1962. Now a new one has arrived to join this company, "The Young Milord" which, if perhaps a little too complex in its satirical libretto to win it total acclaim nevertheless contains much to recommend it.

The main body of the story, which, however, has many digressions, tells of a titled English resident in a small German town who resents having his privacy disturbed by the advances of a snobbish bourgeois population prepared to gush over him, but who when snubbed, turn violently antagonistic. To get rid of his tormentors once and for all the eccentric Englishman opens his house to his neighbours for them to meet his nephew, Lord Barratt. He is given an awed welcome despite his silence, which the Germans put down to his English reserve. The prettiest girl in the village imagines she is in love with him. In short everyone is at his feet until the disclosure, in the last act, that he is a trained ape.

To this story, in which many might claim to find many allegorical meanings, Henze has provided much delightful music which includes many bouncy dance tunes and ingenious ensembles. In fact, the ensembles are the main feature of the opera since, except for the young girl's contributions, there are no long solo passages and only one duet — between her and her former young sweetheart. Although much of this music pays a generous tribute to Stravinsky it is none the worse for that reason. It is firmly based on tonality with a good deal of overlying polytonality. But a few runs through should accustom one to the composer's idiom — that is, the readers who have progressed beyond Richard Strauss.

If you still find "Salome" and "Elektra" cacaphonous, "The Young Milord" is not for you, despite its brilliant ensembles, its sharp-edged characterisations and its numerous orchestral ingenuities. But more adventurous spirits should find much to delight them in Henze's witty score, full of bitter comments and caricatures and unremittingly entertaining. The recorded performance is brilliantly precise and all 16 of the soloists, though they rarely communicate more than a few bars each at a time, are faultlessly cast. Among these I choose Edith Mathis, Patricia Johnson, Lisa Otto and Helmuth Krebs for special mention only because of the importance of their roles, though there is not another member of the cast I would have changed.

Great praise is also due to DGG's superb engineering which remains beautifully clear and faithful even during the most complex passages. Some readers might miss an English translation of the libretto which is given only in German, but the plot is outlined in English in such detail that few points will be lost. I found the whole great fun.

★ ★ ★

**BRITTEN—The Burning Fiery Furnace. Second Parable for Church Performance. Peter Pears (Nebuchadnezzar); Bryan Drake (Astrologer); John Shirley-Quirk (Shadrach); Robert Tear (Meschach); Stafford Dean (Abednego); Peter Leeming (Herald). Monks and Acolytes and small orchestra directed by Benjamin Britten and Viola Tunnard. Decca Stereo SET356.**

In quite a different class is this Britten work which, while perhaps lacking the dramatic impact of the composer's previous "parable for Church performance," (Curlew River), has much to recommend it. The form is much the same as you find in the predecessor, with monks acting out a mystery play, the same ceremonious instrumental processions, and the monks chanting plainsong as they enter and leave the church. The biblical story is too well known to need any comment from me, and Britten has decorated it with his customary fertile invention and a genuine feeling of deep piety. As usual — if one excepts the "War Requiem" Britten uses only a small orchestra with virtuoso technique, adding a small sweet-toned organ with delicious effect.

But the parable is not all earnest comment — you might even find some evidence of satirical glances at our modern capitalistic society — but abounds in charming light interludes. All the principals are in fine form, Peter Pears, John Shirley-Quirk, Robert Tear and Stafford Dean. The musical direction is first rate, stressing the inferential rather than the explicit character of the music. An unusual feature of the engineering offers much of the score with sharpest-edged definnition imaginable, contrasted against less clear, more deliberately hazy sound. Altogether an excellent producion and no Bitten fan will be able to resist its many temptations.

★ ★ ★

**BRAHMS — Serenade No. 1 in D Major Op. 11. London Symphony Orchestra conducted by Istvan Kertesz. Decca Stereo SXL6340.**

This is an early work of Brahms and is almost symphonic in structure, with the Adagio presaging the great slow movements that were to come later in the symphonies. The second scherzo looks back to Beethoven, but the feminine sixths in the minuet are all pure Brahms, a characteristic which remained with him to the end of his life. There are six movements in all, set out rather in the manner of a Mozart serenade, although after that all other resemblance is absent. Brahms revised it several times and it is presented here in its final form, with a strong but pleasing rustic atmosphere and beautiful playing by the L.S.O. under Kertesz. The engineering is admirable and the disc should appeal to all who are looking for something new from an old friend.

★ ★ ★

**BELLINI — Norma. Abridged Opera. Elena Suliotis (Norma); Carlo Cava (Orovesco); Mario del Monaco (Pollione); Fiorenza Cossotto (Adalgisa); Guiliana Tavolaccini (Clothilde); Athos Cesarini (Flavio). Chorus and orchestra of the St. Cecilia Academy, Rome, conducted by Silvio Varviso. Decca Stereo SET368/9.**

I am much less enthusiastic about this set, which omits many beautiful sequences — among them what is perhaps the opera's most important chorus — to get it on to two discs. Other cuts of important passages will also irritate those who know the complete work. And another irritating factor might be del Monaco's characteristically brash contribution which is almost continuously too loud though I must admit he has a few splendid moments. I also found the young soprano Elena Suliotis disappointing after previous recordings of hers I have heard, notably Verdi's "Nabucco." In "Norma" she used her naturally powerful voice with less discretion, pushing it up to levels where strain is only too apparent. However, she is still young enough to be trained away, in the right hands, from such excesses. But even she, too, has her alluring moments when she

sings with ravishing delicacy. But they are all too rare for my liking.

The outstanding performance to my mind comes from Fiorenza Cossotto who maintains throughout a fastidious sense of style and tonal quality of outstanding beauty. Varviso's conducting is brisk rather than sensitive, but I got the impression that the orchestra was not always as generous as it might have been to his promptings.

★ ★ ★

**MOZART — Requiem Mass. Edith Mathis (soprano); Grace Bumbry (mezzo-soprano); George Shirley (tenor); Marius Rintzler (bass). New Philharmonia Chorus and Orchestra conducted by Rafael Fruhbeck de Burgos. H.M.V. Stereo SAN 193.**

Fruhbeck de Burgos' reading of the Requiem sounds at first more operatic than pious, rather in the manner of the Verdi Requiem, or, if it isn't too fanciful, like one of the dramatic baroque churches of his adopted country, Spain. And he employs much larger resources than would be likely in a church. Although such an interpretation might truthfully be labelled unorthodox, I found most of it exciting. After all, the drama is there, in the music, so why not play it up? Too often such works suffer from a sort of rigor mortis, with everything fixed in an unchangeable rictus. I am all for Fruhbeck's spirit of adventure.

He uses two splendid principals, Edith Mathis, a soprano with a consistently lovely quality, and Marius Rintzler, a bass who can only be described as stately in his phrasing and production. From his performance here he would make a magnificent Sarastro in "The Magic Flute." Grace Bumbry is a shade less satisfactory in her middle and top registers but excellent in the lower. The New Philharmonia Chorus and Orchestra live up to the great reputation they have justly earned for precision, nuancing, and consistently pleasing tone. If you're prepared to bear with Fruhbeck's intensely personal reading. I doubt whether a better recording will show up for quite a while. The engineering is first class, too.

★ ★ ★

**SIBELIUS—Symphony No. 6 in D Minor, Op. 104. Symphony No. 7 in C Major, Op. 105. Berlin Philharmonic Orchestra conducted by Herbert von Karajan. DGG Stereo 139032.**

Karajan uses a more romantic approach to Sibelius than did the English conductors who won fame in the presentation of his works during the period of his greatest popularity, the 1930s. Where conductors such as Beecham and Anthony Collins stretched Sibelius' taut melodic line almost to breaking point and made his landscapes seem uninhabited, Karajan sets him down afresh in the main line of central European development. He uses the balance of his orchestra to blend the composer's strong primary colours rather than keep them starkly separate as did the English school. I might mention here that the English conductors, through personal knowledge of the composer, must have played the works more to his liking. Sibelius' scores

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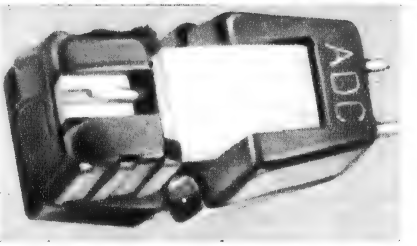


**THE ADC POINT FOUR CARTRIDGE, released 1963**

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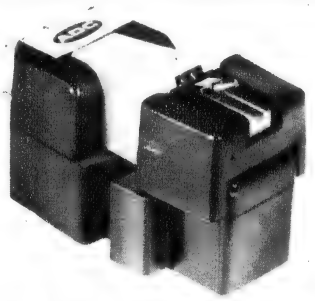

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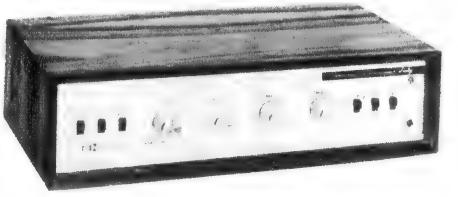

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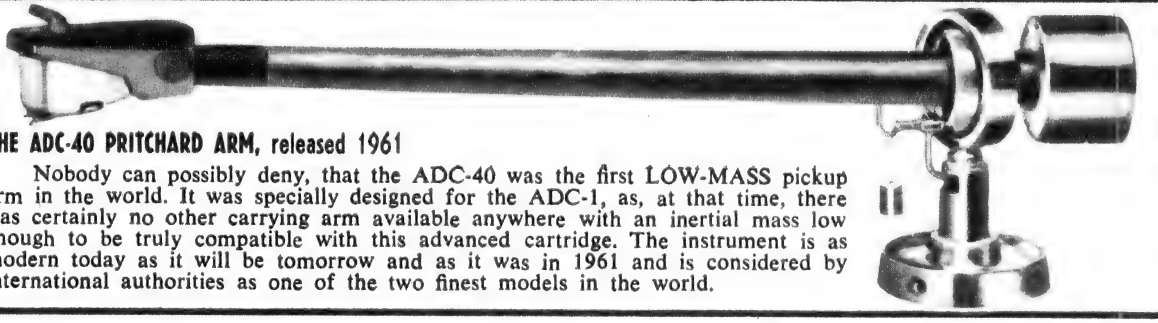

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bear a minimum of marking to indicate just how he wanted them played.

Karajan uses a more humanistic approach, warmer, and at times, even ardent. Some might approve of this treatment, others might not. But whatever your opinion of Karajan's interpretations of both works all should agree that the Berlin Philharmonic plays quite wonderfully under his direction and DGG's engineering is superb. Indeed I know of few modern recordings to have captured such sumptuous sound.

★ ★ ★

**MOZART—Piano Concertos No. 13 in C Major (K.415), and No. 17 in G Major (K.453). Daniel Barenboim, soloist, and conductor of the English Chamber Orchestra. H.M.V. Stereo OASD2357.**

**MOZART—Symphony No 35 in D Major. (K.385) (The Haffner). Symphony No. 38 in D (K.504) (The Prague). Symphony No. 32 in G. (K.318).**

In the first of these discs, that vastly gifted young musician Daniel Barenboim acts as both soloist and conductor; in the second as conductor. He is tremendously successful in both capacities. In the piano concertos he uses a touch that is never dry, but excellently nuanced to win the maximum of poetry from the beautiful scores. And though he is playing while conducting he still manages to keep an impeccable balance between the solo part and the generous response of the English Chamber Orchestra. I doubt if anybody would query the validity of a single one of his tempos. And his dynamic range, though unfailingly eloquent, always remains within the limits set by Eighteenth century tradition. Added to all these virtues is the engineering, at once lively but sensitive. I found every bar completely entrancing.

In the symphonies — the K.318 is really an overture in one movement with its two fast sections separated by a slow one — the English Chamber Orchestra again responds with affection to their young conductor's most exacting demands. In the "Haffner," for instance, the first movement moves joyously, though some might think it a little fast; the Andante's beauties are explored and revealed with such delicious inflections that it remains imperishably fresh; and the prestissimo Finale slips by so fleetly that one marvels at the accuracy of the players' articulation.

Barenboim uses a bigger style in the "Prague" to produce a reading that is at once muscular in its phrasing but always supremely lovely in tone. The little K.318 makes a refreshingly "new" fill to an enchanting disc.

★ ★ ★

**BERLIOZ — Symphonie Fantastique. Overture to "Le Corsaire." Swiss Romande Orchestra conducted by Ernest Ansermet. Decca Stereo SXL6343.**

Frankly, I was very disappointed with this issue. Although the Swiss Romande cannot be counted among the world's greatest orchestras I had hoped they might have acquitted themselves better in the Symphonie Fantastique. I thought they would have found the work itself more compatible than they apparently do, and in this statement I include both the orchestra and conductor. Neither are at their best and preferable versions are too numerous to mention. I still remember the old Beecham recording with affection and even nowadays its engineering is not to be despised.

Some slight compensation might be found in the fill, "The Corsair" Overture, which has some attractive swagger. But otherwise I am afraid I cannot recommend the disc.

★ ★ ★

**HANDEL — Organ Concertos. No. 1 in G Minor; No. 5 in F Major; No. 13 in F Major (Cuckoo and the Nightingale); No. 14 in A. Simon Preston (organ) with the Bath Festival Orchestra conducted by Yehudi Menuhin. HMV Stereo OASD2352.**

Most of Handel's Organ Concertos have been recorded many times, but in my opinion, never so completely satisfactorily as they are here. In the first place, Preston uses a sweet-toned baroque organ in preference to a Victorian giant with the most felicitous results. By the way, some readers might be interested to learn that the pipes come from an organ in use during Handel's lifetime, and now installed in a Mander organ in London's Merchant Taylors' Hall where this disc was recorded. They might also be interested in the edition Preston uses, which was prepared by the Handel scholar, N. D. Boyling.

Preston uses this edition as might have been done in the early 18th century, adding decorations and extensions of his own which are the result of careful study of performing techniques of the period. I hope I do not appear to be unjustly disparaging of other organists when I remark how beautifully clear and rhythmic is Preston's playing. And it must be remembered that the organ, with its supreme difficulties of accentuation, is probably the most difficult instrument in the world to play rhythmically. Unfortunately little can be heard of Colin Tilney's contribution in the harpsichord continuo, but one would probably hear little more in a concert hall, and the engineers deserve praise for not monitoring it up and so destroying the perfect balance Menuhin has achieved throughout the performance.

He coaxes a sturdy, Handelian tone from the Bath Festival players, but richness is not neglected, nor sensitive variations of dynamics. Altogether a rewarding experience that should provide comforting company to its owners for many a long year.

★ ★ ★

**FROHBERGER — Clavichord Music. Thurston Dart. Record Society Stereo S/6286.**

I found this a deliciously refreshing disc with a fragile, haunting beauty all its own. Those not used to early 17th century music should remember that the clavichord is not a harpsichord. The instruments produced their notes in quite a different way and Frohberger left no indication of which instrument he wished them to be per-

formed. Most musicians play them on a harpsichord, and thus sacrifice much of their delicate charm. Thurston Dart, a leading authority on such matters, in his learned and interesting sleeve notes should convince everyone that Frohberger had the clavichord in mind. And if these do not convince you, his playing of the brief gems should.

Particular attention should be paid to Dart's advice on how to set your amplifier controls to get the best results, since the recorded sound is always very soft and any attempt to overamplify will only lead to disappointment. I also found playing through the whole recital at one sitting a little too much — it tends to monotony. Better to listen to three or four of the pieces at a time. In that way you should have many hours of refreshing entertainment ideally suited to a mood which seeks relaxation.

★ ★ ★

**MAHLER — Kindertotenlieder. Lieder eines fahrended Gesellen. Ich bin der Welt abhanden gekommen. Janet Baker (contralto) with the Halle Orchestra conducted by Sir John Barbirolli. HMV Stereo OASD2338.**

You can hear much beautiful singing from Miss Baker in this recital. And there are moments when she seems to communicate everything the composer had in mind when he wrote these eloquent song cycles. But there are some items in which she seems to be more interested in producing a lovely tone than in interpreting the composer's desires. A purely sensuous appeal dominates these items. And in this she is encouraged by Barbirolli's accompaniments which are sometimes a shade too ardent, even to the point of distortion of the music as it is usually performed. However, those to whom such enchanting sounds are all important — and they are many — might well overlook the recital's occasional eccentricities.

★ ★ ★

**LUCIA POPP sings Mozart and Handel. Soprano with English Chamber Orchestra conducted by Georg Fischer. HMV Stereo OASD2334.**

So far as I can trace, this is the first solo recital of this alluring, very young Czech singer. Her range is extraordinarily wide even for a top coloratura soprano, and is commendably even throughout every register. Her voice also has unusual power, mercifully free from shrillness. In short, her's is a brilliant clear voice used with true musicianly instincts. I found only one aspect of her recital that was ever so slightly disappointing. The sheer weight of her voice makes a floating tone, that aspect of coloratura singing which seems to separate the voice from the body, seldom in evidence, though this in no way impairs her impressive achievements. However, since she is still in her very early 20s, it is a feature that she might well acquire with further study. The accompaniments by George Fischer, and, once again, the prestigious English Chamber orchestra, are always exemplary. ■

# DOCUMENTARY RECORDS

## *Reviewed by Glen Menzies*

**"MAN OF LA MANCHA." The Complete Musical Play with the Original London Cast. Keith Michell, Joan Diener, Bernard Spear and Company. Produced by Albert Marre. Musical Supervision by Mitch Leigh. Festival double album, Stereo SDL-933098/9.**

I must admit that I felt very sceptical about the possibility of anyone devising a musical based on Cervantes' great masterpiece of "the Knight of the Woeful Countenance," Don Quixote. How could the spirit of a work of such magnitude be captured in this format? Wouldn't it all be just a patchwork quilt or at its best, a sketchy caricature? "Man of La Mancha" is far from this, and it is known that the three people who collaborated in its creation found themselves becoming more and more caught up in the spirit of Cervantes' classic. It is described as a musical play and this is a fair description because running through it is a strong vein of drama. In fact, when I saw "Man of La Mancha" on stage early last year, this dramatic element was one of the most memorable features of the work.

This album captures all this in sound and is a fine recording of one of the most refreshingly different musical shows of the past decade. Australian-born actor Keith Michell makes a strong showing in the dual role of Cervantes and Don Quixote. I have long known of his talent as an actor but was surprised at his excellent singing voice, not only powerful but also capable of capturing all the nuances of the roles. Joan Diener as the fiery and passionate Aldonza is a fine dramatic actress with a strong, clear singing voice. She is not known to me but I hope to hear more of her as an actress and singer. Bernard Spear sounds perfectly in character as the sensible down-to-earth Sancho Panza.

Among the songs "The Impossible Dream" enjoys hit status both in and out of the show but I have always thought of the romantic "Dulcinea" just as highly; and the "Man of La Mancha (I Don Quixote)" is thoroughly invigorating, the kind of song that the late Peter Dawson would have revelled in.

The carefully prepared cover note plots the progress of the story from beginning to end, which is a great help to anyone who did not see the show. There is, of course, a great deal of dialogue of a very high quality indeed — a refreshing change from the string of banalities that usually pass as dialogue in many shows of this kind. The main writing for Cervantes and Don Quixote offers a challenge and Mr Michell's classical training stands him in very good stead here — there are many noble and extremely touching moments throughout.

I am sorry that the cover note omitted to mention the rather unusual orchestration — the only strings used are Spanish guitars; otherwise the orchestral writing is for brass and woodwind alone. On stage the musicians were placed in two distinct groups at the back of the stage and the antiphonal effects achieved by this arrangement were most impressive. It is surprising, on this stereo recording, that the separation is not quite as clear cut as I had expected it to be, but there is nevertheless plenty of stereophonic spread which is well focused.

Mitch Leigh, who wrote the music, in dispensing with the standard body of strings, went against tradition for Broadway shows, but achieved instead a lithe, clean, uncluttered orchestral sound. The guitar players add a dash of colour which is entirely appropriate to the Spanish atmosphere.

In this recorded production movement about the stage is fluid, and sound effects add to the total impact. This album, then, is very much the complete musical play with all the dialogue intact, enabling the casual listener who missed the show to grasp the flow of the story.

★ ★ ★

**"THE RESTLESS YEARS." From a book of the same title by Peter O'Shaughnessy, Russel Ward and Graeme Inson. Published by Jacaranda Press. Spoken by Peter O'Shaughnessy; Songs by Marian Henderson, Alex Hood and Peter O'Shaughnessy. Recording produced by Robert Iredale. Compatible Stereo. JRLS-001.**

It is still something of an event when a book has a record to go with it— all the more so when the record is as good as this 12in L.P. is. The book is described as a tribute to the spirit of the young Australian nation and its vigorous seeking for national identity. There are 13 chapters which help to throw light on the distinct stages of our history.

All this grew out of the award winning TV program of the same name in which Peter O'Shaughnessy played a dazzling assortment of roles. The book is actually a clever compilation of illustrated verse, ballads, documents and paintings, and the record is meant to complement it. The narrative spoken by Peter O'Shaughnessy lends vitality to the documents and drama to the verse. In other words, it is a kind of easily digested history of the making of the nation, which does not flinch to look more closely at some of the more discreditable aspects of our early settlement and the cruelty meted out to both convicts and Aborigines alike.

This record is far from being a mere hotch-potch of bits and pieces from the book, it stands as a fine production in its own right in which the performances are of a high professional standard. Once again, Peter O'Shaughnessy astounds us with the range of characterisations offered. The other artists on this album all deserve the highest praise. Marian Henderson is a folk singer of taste with a voice capable of expressing much warmth and feeling, and Alex Hood's voice is well suited to the lighter folk songs.

Not named on the label are Richard Brooke, the tasteful harmonica player, and bassist Ron Carson. Robert Iredale's production is of a very high standard.

# The BBC's Gramophone Library

So rich and varied are the contents of the BBC's gramophone library, built up over forty years of broadcasting, that a distinguished musician once likened it to "an oriental warehouse." It has to be, in order to feed the vast frontier of entertainment represented by many different kinds of programs broadcast in the BBC's domestic and overseas services. It contains over half a million commercial records and some 7,000 historical "archive" records, of which 75 per cent have no known matrix.

One and sometimes three or more copies of every record issued in Britain are purchased by the BBC gramophone library. There are 700 different makes, and thousands of prefixes and numbers. Any record can be located within forty seconds by means of a huge card catalogue showing some 600,000 titles, 320,056 composers and nearly 45,270 artists. There are, for instance, 66 different recordings of Schubert's "Unfinished Symphony," 73 recordings of Beethoven's 5th Symphony, and 315 of the "Blue Danube." About 11,000 records are lent out to BBC producers each month.

Highly prized records in the archive collection include: Marie Tempest singing "The Jewel of Asia," in her part of Mimosa San, from "The Geisha"; a 7-inch Berliner Edna May — the original "Belle of New York" — singing "The Purity Brigade" from the show, a record made in 1900; and Victor Maurel singing Hahn's "L'Heure Exquise," a record made in Paris in 1903 and valued at £100. Non-musical "museum" records include speeches by Robert Browning, Stalin, Lenin, the Emperor Franz Josef, Puccini, Carmen Sylva (Queen of Rumania), King Alfonso of Spain, and Rudolph Valentino.

It serves practically every kind of BBC program, not only essentially record programs like "Listeners' Choice" and "Composer of the Week," but dramatic, documentary, and other programs with incidental music, and biographical and historical programs in which the voices of many famous people are heard. ■

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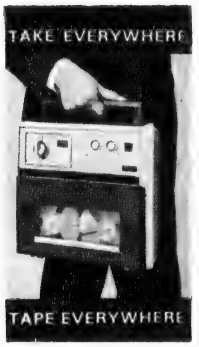


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# VARIETY FARE

**Reviews by: Neville Williams  Harry Tyrer**
**T. Forbes Cameron**

## Devotional

**TO GOD BE THE GLORY. Bill Newman with Reubert Hayes at the organ. Mono, Festival FL-33,038. Also in stereo SFL-933,038.**

Interest: Old-time hymns.
Performance: Robust.
Quality: Good.

Featured regularly on the Bobby Limb TV series "Sound of Music," Bill Newman will need no introduction to the majority of Australian record buyers. On this album he sings a round dozen old-time hymns that will be familiar to most church goers: To God Be The Glory — Rock of Ages — Onward Christian Soldiers — How Sweet The Name of Jesus Sounds — Oh God Our Help In Ages Past — Oh Boundless Salvation — Praise My Soul The King of Heaven — The Old Rugged Cross — Blessed Assurance— When I Survey The Wondrous Cross — There Is A Green Hill Far Away — What A Friend We Have In Jesus.

In his characteristically robust, masculine voice, Bill Newman sings each of these hymns in fine style but with very little in the way of variation from track to track. I imagine that the album would be enjoyed most a few tracks at a time, rather than played straight through as one does for review.

At the organ (one of the large Conns, I imagine) Reubert Hayes plays every bit as competently as one expects of him and uses the slow Leslie and reverberation to get a generous big-church sound. His registrations, too, are varied and effective.

But there is still some sense of competition between organ and voice with the organ denied the recognition it deserves. Why not an album featuring solo organ in a couple of the tracks, or with organ taking the occasional verse or a repeat chorus? It would heighten the interest and be an inducement to play the tracks consecutively. (W.N.W.)

★ ★ ★

**JOHN LAWRENSON SINGS FAVOURITE HYMNS. With Garth Benson, organ and the Rodney Christian Fellowship Festival Choir conducted by Ronald Smith-Bishton. Stereo, World Record Club S/2167.**

Interest: Hymns, concert items.
Performance: Competent, enjoyable.
Quality: Excellent.
Stereo: Modest.

A native of Fleetwood, Lancashire, John Lawrenson was studying to be an electrical engineer when a win at the Blackpool Rose Bowl at the age of 21 convinced him that he should take up singing professionally. Since then he has built a firm reputation in opera as a concert artist and with the B.B.C. He has toured Europe and sang for the late President Kennedy in the U.S.A. in 1964.

On side 1 of this album, he appears with the Rodney Christian Fellowship Festival Choir in seven well-known traditional hymns — a fine and generous performance that occupies a full 25 minutes: Praise To The Lord Almighty — When I Survey The Wondrous Cross — Love Divine, All Loves Excelling — Rock Of Ages — He Who Would Valiant Be — My Song Is Love Unknown — For All The Saints.

On side 2, he offers solo performances with organ of: Panis Angelicus —Ave Maria — Rest (Largo, Brown-Handel) — It Is Enough (Elijah, Mendelssohn) — How Willing My Paternal Love (Samson, Milton-Handel)— The Lost Chord (Proctor-Sullivan). Again, the playing time is close to 25 minutes.

Garth Benson gives commendable support at the organ — a rich traditional pipe instrument, while the acoustics of the Church of St. Mary at Redcliffe, Bristol, are well suited to the purpose. On side 1, the choir is excellent.

All told, this is a satisfying performance of well-known hymns and devotional concert items and can be recommended readily to those to whom the titles appeal. It is an H.M.V. recording, by the way, released in Australia only through the World Record Club. (W.N.W.)

★ ★ ★

**THE MAGIC OF BELIEVING. Dionne Warwick. Stereo, Scepter Records (Festival) SJL-932,996. Also in mono JL-32,996.**

Interest: Gospel, extreme Negro style.
Performance: Good in its class.
Quality: Mostly good.
Stereo: Ample separation.

Dionne Warwick, originally a member of the well-known Gospel-Aires group, rejoined the members of her family to make this new all-Gospel album. But those keen on collecting Gospel records shouldn't hurry off to buy their copy just on that account. At least not without being forewarned what to expect.

Dionne Warwick adopts an extreme style — rhythm, blues, improvisation, emotings, unusual tempos — anything in fact to avoid the accusation of singing any of the stanzas "straight."

If you appreciate Gospel music interpreted this way, you're in for a vocal feast. If you don't, you'll have the horrors before the album is half-way through!

The titles: Battle Hymn of The Republic — Somebody Bigger Than You And I — Jesus Will — Old Landmark — The Magic of Believing — Blessed Be The Name of The Lord— Grace — Steal Away — In The Garden — Who Do You Think It Was?

The quality and stereo generally are good but, just here and there, there was some suggestion of tracing buzz on extreme vocal transients. but I don't think this will govern your reaction to the record. Definitely one you should judge for yourself. (W.N.W.)

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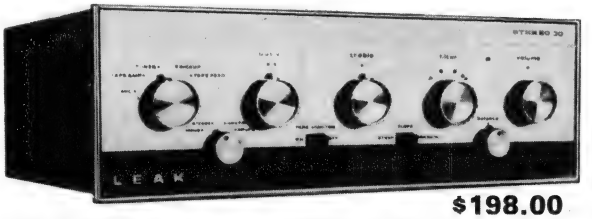


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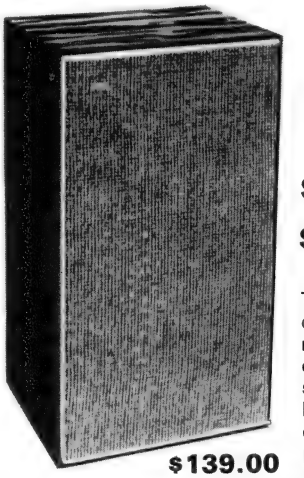

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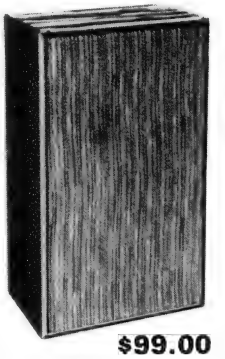

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# Instrumental, Vocal & Humour

**THE MASSED BANDS, DRUMS AND PIPES of the Welsh Guards and Scots Guards. Decca (E.M.I.) Stereo SKLA 4906.**

Interes : See title.
Performance: Pleasing variety.
Quality: Very good.
Stereo: Normal.

The feature about this excellent disc which attracted me the most was the variety between tracks provided by the band of the Welsh Guards. There is not much variety to be expected from pipes and drums and the producers have wisely restricted the solo efforts of the Scots Guards to three tracks, in which they place the usual medleys of quick marches, strathspeys and reels. These are most excellently played, and the precision of the drummers in particular is a noteworthy feature. However, a complete LP devoted to pipes and drums is rather too much of a good thing, so it was an excellent idea to have a conventional military band providing a change of style.

The bands combine in only two tracks — a very brief fanfare which begins side one, and a slow march, "The Highland Cradle Song," on side two. The contribution of the Welsh Guards has wide variety, ranging from "Birdcage Walk," in which the band swings it in the manner of the American bands, to a classical waltz (from "The Seasons" by Glazunov). Particularly effective is "Nightfall in Camp," where a hymn tune is combined very skilfully with "The Last Post." The other tracks are: Trumpets Wild (using a Schumann melody called "Siciliano") — Cardiff Castle (slow march) — Thunderbirds (quick march) — Wheels (quick march)—Regimental Marches (Men of Harlech, Highland Laddie, The Rising of the Lark). The playing of the band is of a very high standard, and the sound engineers have done an excellent job of recording the large forces obviously employed. (H.A.T.)

★ ★ ★

**MOVIE HITS 68-69. Enoch Light and the Light Brigade. Project 3 (Festival) Stereo SPJL-933,047. (Available in Mono.)**

Interest: Hollywood hits.
Performance: Well presented, and swinging.
Quality: Excellent.
Stereo: Well spread.

The success which Enoch Light has achieved with his Project 3 series is due to the care which goes into every aspect of their production. Firstly, he uses a very fine band of musicians, many of whom are very well known in their own right. Then he carefully chooses the material which they will play to have maximum appeal. These tunes are skilfully arranged to make the best use of the instruments available. At this stage, Enoch Light's long experience in the making of high quality recordings comes to the fore (each Project 3 release makes a point of telling you about this, if you are interested). The results are always very pleasing, and I have yet to hear a Project 3 disc about which one could not say nice things. It only remains to give the track titles, and if these appeal to you, you need not let other considerations deter you from putting this on your list of possible purchases.

The Windmills of Your Mind — Mrs Robinson — Old Devil Moon — Hushabye Mountain — Now (Theme from Mozart's Piano Concerto in C, featured in "Elvira Madigan") — The Good, the Bad and the Ugly — Hang 'Em High — Lullaby from "Rosemary's Baby" — Interlude — Funny Girl — Someone to Watch Over Me — March "The Devil's Brigade." (H.A.T.)

★ ★ ★

**YOU'RE GONNA HEAR FROM ME (US!). Trombones Unlimited. Liberty (Festival) Stereo SLYL-932,894. Available in Mono.**

Interest: Current hits.
Performance: A la Tijuana Brass.
Quality: Excellent.
Stereo: Normal.

Whether they deny it or not, and whether intentional or not, Trombones Unlimited performances have a distinct resemblance to the Tijuana Brass sound. The two trombones replace the trumpets of Alpert and Moss, but otherwise the instrumental grouping is pretty well identical, with guitars, marimbas or vibes, maracas and the more prosaic instruments which complete the assembly. The resemblance is completed by the use of mariachi rhythms. Where this group does score over Alpert's group is in the superiority of the arrangements. In Eddy Karam they have a master craftsman who knows just how to make the best use of what a melody has to offer, If you want to sample just what he can do, listen to "Arabesque" on this disc. Some of the other tunes are rescued from mediocrity by Mr Karam's treatment.

The title line up consists of: Walk with Me — Arabesque — The Work Song — Trains and Boats and Planes — Summer in the City — You're Gonna Hear From Me — Copy Cat — Modesty — Sunrise, Sunset — Mame — Summer Samba — See You in September. The sound is of excellent quality. (H.A.T.)

★ ★ ★

**HISTORIC ORGANS OF SPAIN. E. Power Biggs. CBS (Australian Record Company) Stereo SBR-235269.**

Interest: As per title.
Performance: Not the main interest.
Quality: Well recorded.
Stereo: Restricted.

Although the music in this collection is pleasing and interesting, and the performance is very competent as one would expect from this artist, the main interest is in the instruments played. This, then, is mainly a disc for the organ enthusiast rather than the lover of organ music.

The organs of Spain are unique. In the semi-isolation of the Iberian peninsula in the post Rennaissance period, organ builders developed organs unlike those found in other parts of Europe, and the arrangement in the cathedrals was also unusual. The organ "loft" was placed in the centre of the Nave and the usual arrangement was effectively two

organs facing opposite ways. Since the choir was grouped around the double organ, this part of the church was known as the "coro."

The cathedral organs were provided with an array of "Trompetas Reales" which were full-length resonators arranged to project horizontally over the front of the instrument in a "fan-like array." The trompetas of the double organs faced each other across the coro while a further array at the rear was arranged to speak into the body of the church. This arrangement lent itself admirably to antiphonal effects on the grand scale and one can imagine the magnificent sounds which were created for the major church feasts. Toledo Cathedral has a further organ mounted over the main entrance which was used for great Church and State occasions. This is the Emperor Organ played first in this recital.

From the arrangements played here, it is obvious that the Spaniards greatly favoured the reed stops, since these figure prominently in many pieces. However, Biggs has chosen pieces to demonstrate the other features of the great instruments, which cannot be covered here for space reasons. The organs played, apart from the Emperor Organ mentioned above, are those at Segovia, Salamanca and the Royal Palace at Madrid (the latter being a smaller-toned instrument of no particular significance). The composers represented are Soler, Angles, Seixas, Cabinilles, Pasquini, Milan and Valenti. Several pieces are anonymous. (H.A.T.)

★ ★ ★

**SCHUBERT PIANO RECITAL. Andre Tchaikowsky, piano. World Record Club Stereo S/4440.**

Interest: Featherweight piano classics.
Performance: Satisfactory.
Quality: very good.
Stereo: Restricted.

The pieces included in this recital are those engaging trifles which Schubert used to turn out at the drop of a hat, intended mainly for performance at the Schubertiads rather than for publication. Although all endowed with the most pleasing melodies, when played all together as in this disc, the lack of substance becomes only too obvious and I doubt the wisdom of presenting them in this way. I think their greatest use lies in providing fills for discs with weightier works, where they provide excellent contrast and light relief. Dedicated Schubertians, of whom there are a great many, will certainly want this disc in their collections, since the pieces are nicely played with the artless simplicity which they require, and the sound quality is of high standard. Others may well consider the above remarks before making any decision.

The program consists of: Twelve Laendler, op. 171—Waltzes, Nos. 1, 2, 6, 8, 9 and 10, op. 18—German Dance op. 33, No. 7 — German Dance ("Laendler") D.366 — Two German Dances, D.769—Valses Nobles, Nos. 9 and 10, op. 77—Waltzes, Nos. 19, 21, 22, 26, 29, 30, 32, 34, 35 and 36, op. 9—Waltzes, Nos. 15 and 18, op. 127 (Letze Waltzer)—Valses Sentimentales, Nos. 1, 19, 27, 3, 7, 15, 12 and 13, op. 50. This impressive list makes a generous program lasting about 45 minutes. (H.A.T.)

# Reader's Digest Album

**LISTENING AND DANCING. Lawrence Welk and his Champagne Music Makers. Stereo, 6-record set, "Reader's Digest.**

Interest: Listening, dancing —please yourself.
Performance: Smooth, pleasant.
Quality: Good.
Stereo: Normal.

A column running through the six jackets tells the story of Lawrence Welk's gradual rise from a small-town musician, through the brighter spotlights, to U.S. national radio and then, in 1955, to national television. It has quite a deal to say also about some of the well known musicians who have worked with him or who are still featured players in his band. Each number played is the subject of appropriate comment on the particular sleeve.

This is music that is intended to have wide appeal and its continued acceptance on television is proof enough that it does have this vital quality. The term "champagne," by the way, was picked up somewhere along the radio trail; it is intended to communicate a sense of pleasant bubbling sound. Enough said!

Record 1 contains a dozen danceable Welk hits — his theme "Bubbles In The Wine," several medleys, "Maria," "Get Me To The Church On Time," and others.

Record 2 continues the variety under the general title of "Champagne Dance Party" on side 1 and "Ballroom Saturday Night" on side 2. More medleys, "On The Street Where You Live," "I've Grown Accustomed To Her Face," "Temptation," "That Old Black Magic," "The Trumpet Rag" and others.

Record 3 is more definite — Viennese style waltzes on side 1, with a fairly generous orchestral sound. On side 2 is "Polka Fun Party," featuring Myron Floren and his accordian and the happy sound of a half-dozen polkas including: "Tic-Tock," "Kit-Kat" and "Dancing Fingers".

"Dixieland Dance Party" is the theme of record 4 side 1 and Lawrence gives the dixieland treatment to "My Bonnie Lies Over The Ocean," "Where Has My Little Dog Gone?," "The Bear Jumped Over the Mountain," etc. Listen and smile. On side 2 is "Latin and Lovely," with such numbers as "Perfidia," "Fiesta" and Marianne".

Buddy Merill takes the spotlight on Record 5 side 1 with a "Songs Of The Islands" theme and the kind of Hawaiian style song that you would expect. Side 2 reverts to "Welk's TV Hits" including "Wives And Lovers," "Baby Elephant Walk" and "Winchester Cathedral".

Record 6 (or rather side 1) suggests "Let's Sit This One Out," which allows Welk to stretch tempos as he likes for a few numbers like "You Belong To Me," "Where The Blue Of The Night" and "Drink To Me Only". the album winds up with some more danceable tempos: "Carolina In the Morning," "People Will Say We're In Love," "If I Loved You" and three others.

Carrying a"Festival" label—a change for "Reader's Digest"—the pressings are of eminently satisfactory quality with adequate stereo separation. Interestingly enough, the sound quality and balance changes very little when the tracks are paralleled for mono and I would not have been at all surprised to find some endorsement along the lines "compatible stereo/mono". More to the point, I would expect the mono version to be very acceptable. (W.N.W.)

**HOROWITZ ON TELEVISION. Vladimir Horowitz. C.B.S. (Australian Record Company); Stereo MS 7106.**

Interest: Piano recital.
Performance: Brilliant technique.
Quality: Good.
Stereo: Not important.

I have never been entirely happy about Horowitz recordings for the odd reason that his technique is so perfect. By this I mean that most of the time one is conscious of the technical excellence cutting across the musical enjoyment. This is, of course, far better than being aware of bad technique, but the performances I enjoy best are those like Artur Schnabel's reviewed elsewhere, in which the technique is entirely subservient to the music, not on equal terms with it and competing for the listener's attention.

Having said this I must now admit that I obtained tremendous pleasure from the Chopin pieces which make up side one of this disc. The G Minor Ballade with which the recital begins is exquisitely played, and the Nocturne in F Minor, as well as the Polonaise in F-sharp Minor which ends the side are both splendid examples of the way an artist of Horowitz's stature can shed a bright light on the genius of this often decried composer. If only Horowitz had kept to Chopin for the whole program I should have had no cause to complain. Unfortunately, the second side does not live up to the high promise of the first, comprising as it does such trifles as Schumann's "Traumerei" and "Arabesque, op. 18." The other pieces are two Scarlatti Sonatas (L.23, L.335), Etude in D-sharp Minor (Scriabin) and finally Horowitz's own creation, "Variations on a theme from Bizet's Carmen."

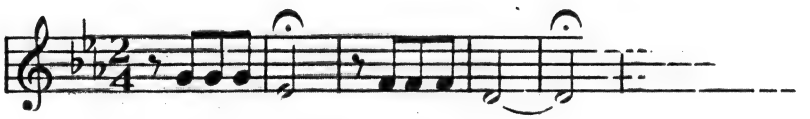
The sound, taken from the sound track of a video recording, is possibly not quite up to the standard of the best modern recordings, but one is not aware of this without careful listening. Audience applause is restricted to the beginning and end of the recital, and extraneous noise during the recital is very minor. (H.A.T.)

★ ★ ★

**GREAT INSTRUMENTALISTS: ARTUR SCHNABEL. His Master's Voice (E.M.I.) Mono only HQM 1142.**

Interest: Piano classics.
Performance: Superlative.
Quality: Excellent remaster.

Artur Schnabel was almost universally regarded as "the greatest living pianist" in the 1930s, and this in a generation which included such notable artists as Moisewitsch, Solomon, Artur Rubinstein, Horowitz, Myra Hess and many others of similar calibre. It is perhaps some indication of his stature that his cycle of the Beethoven piano sonatas, remastered from 78 rpm discs, is still current in the E.M.I. LP catalogue, having enjoyed an uninterrupted run of 20 years. He was



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particularly noted for his Beethoven performances (which makes the absence of Beethoven from this performance noteworthy) but he was acclaimed for his Schubert, Brahms and (later) Mozart.

The program here comprises: Rondo in A minor and Sonata No. 16 in B flat (Mozart) — Impromptus Nos. 2 in E flat and 4 in A flat (Schubert)— Invitation to the Dance (Weber) — Rhapsody in G minor, op.79, No. 2; Intermezzi, in A major, op.116, No. 2 and E flat, op.117, No. 1 (Brahms). These performances reveal a fluid technique completely dedicated to the service of the music, with never a trace of meretricious showmanship. However, most of the pieces are too short to do full justice to Schnabel, the architect of great performances, and it is only in the Mozart sonata, which proceeds smoothly and unhurriedly to an entirely logical conclusion, that one can discern the fine musical intelligence behind the performance. The inclusion of the Weber piece was a mistake — one can detect a slight hint of impatience here — but otherwise this is an absorbing performance from which I derived great pleasure. The E.M.I. technical staff have done a fine job of remastering, and one is never conscious of the age of the originals. (H.A.T.)

★ ★ ★

**A BOUQUET OF HITS. Ferrante and Teicher. United Artists (Festival) Stereo SUAL 933044 (available in Mono).**

Interest: Piano duo with orchestra.
Performance: Slick style.
Quality: First class.
Stereo: Spacious.

This glossy production is as elegantly mounted as other Ferrante and Teicher releases, with large orchestra playing expertly scored arrangements to which the two duettists contribute slick-fingered contributions. If you have heard Ferrante and Teicher, you will know what I mean; if you haven't, this release featuring the latest hits is as good as any to make the acquaintance of this popular pair. The tunes are: MacArthur Park—By the Time I Get to Phoenix—Love is Blue—Theme from "Valley of the Dolls" — Two Different Worlds — Theme from Mozart's Piano Concerto in C (as used in "Elvira Madigan") — The Good, the Bad and the Ugly—Honey — Goin' out of My Head — A Man without Love — Sunny — Why. The engineering is excellent. (H.A.T.)

★ ★ ★

**THE ARTISTRY OF JORGE MOREL. Jorge Morel, guitar. RCA Dynagroove Stereo LSP-3953. Available in Mono.**

Interest: Brilliant guitar playing.
Performance: World class.
Quality: High standard.
Stereo: Good.

When no less a person than Chet Atkins says another guitarist is "one of the best guitar players in the world" one is inclined to sit up and take notice. Jorge Morel is well worth noticing. His is undoubtedly an exceptional skill. Within his own field, this young Argentinian musician displays the same kind of dexterity on the guitar that Segovia does in the classical field. Clean and crisp finger work and finely judged phrasing combine with the essential expressiveness without which guitar playing has little meaning.

Side one begins with "West Side Story" Medley (I Feel Pretty—Maria —America), and this is followed by a short piece entitled "Spring Theme" written by Morel for his own performance—a tuneful and lively piece. The rest of this side is taken up by the music of George Gershwin, comprising Prelude No. 2, themes from "Rhapsody in Blue" and tunes from "Porgy and Bess." Side two is all Latin American, including four pieces by Morel (Surena—Pampero—Olga—Carinosa) together with "Misionera" by Bustamente and "Chopi" by Escovar. Although Morel shows that he is not lacking in skill as a composer, I did find the two pieces not of his making the most interesting, with their lively rhythms and attractive melodies. Excellent orchestral backing is provided in most tracks. (H.A.T.)

★ ★ ★

**WARM, WILD AND WONDERFUL. Tony Mottola, guitar, with orchestra. Project 3 (Festival) Stereo SPJL-933,045.**

Interest: Popular guitarist.
Performance: Very smooth.
Quality: Excellent.
Stereo: Good spread.

Here is another fine disc to add to the series made by Tony Mottola for Project 3, sounding, if anything, even more smoothly relaxed than the others. Supported by the usual group of fine musicians used by Enoch Light for all his recordings, Mottola presents in gently swinging style the following 12 tunes: This Guy's in Love With You — Do You Know the Way to San Jose — Dream a Little Dream of Me — With a Little Help — Scarborough Fair — Watch What Happens — By the Time I Get to Phoenix — Kites are Fun — Cry Me a River — Goin' Out of My Head — Love in Every Room — I Found Love. A good selection, providing very pleasant listening and excellently recorded. (H.A.T.)

★ ★ ★

**AL HIRT PLAYS BERT KAEMPFERT. RCA Dynagroove Records. Stereo LSP-3917. (Also in mono.)**

Interest: Trumpet virtuoso.
Performance: Very pleasant.
Quality: Superbly recorded.
Stereo: Well balanced.

There is no doubt that the 46-year-old Al Hirt possesses a remarkable trumpet technique. In his early years as a musician, he worked for well-known leaders like Ray McKinley and Jimmy and Tommy Dorsey. Subsequently he formed a Dixieland group with Pete Fountain, which helped him to achieve national fame in the early 1960s.

As his reputation and economic fortunes grew, however, his musical taste diminished and his playing in recent years has often lapsed into spectacular vulgarity. Happily, on this album Al Hirt abandons his exhibitionism and needless displays of technique and concentrates on playing

very acceptable and enjoyable trumpet.

Part of this transformation is undoubtedly attributable to the influence of Bert Kaempfert's previous and very successful recordings of the songs. Some are well-known Kaempfert compositions like "Spanish Eyes," "Magic Trumpet," "Swingin' Safari," and "Strangers in the Night"; while the remainder were big successes for his orchestra, like "Bye Bye Blues," "Wonderland by Night" and "Red Roses for a Blue Lady."

The arrangements by Leroy Kirkland are competent and stay fairly close to the original Kaempfert scores. The backing orchestra, incidentally, features an excellent trombone section.

The many devotees of Hirt's playing will certainly want to add this record to their collections. The less enthusiastic may be pleasantly surprised by Hirt's restraint and the very enjoyable music in the album. The playing time however, is a bit short at 32 minutes. (T.F.C.)

★ ★ ★

**GUITAR ARTISTRY. Siegfried Schwab (guitar) with trio. Universal Record Club Stereo U-932.**

Interest: Popular guitar.
Performance: Outstanding.
Quality: The best.
Stereo: Effective.

This 1968 recording is issued in Australia exclusively on the Universal Record Club label, and represents something of a scoop for the club. This is a very fine disc indeed. Recorded in Germany by Liberty Records, it features artists virtually unknown here — Siegfried Schwab playing lead guitar supported by Adie Feuerstein, flute, Jurgen Ehlers, bass and Dai Bowen, drums. Siegfried Schwab handles his instrument with great skill and sensitivity and the ensemble work of the group is superb. I particularly liked the flute contributions by Adie Feuerstein, which play a major part in most of the arrangements. The work of the drummer is never intrusive, but adds effectively to the overall sound patterns. The sound quality is of the highest standard, with good stereo spread.

The selection of tunes also has considerable appeal: Love is Blue — A Man and a Woman — Ode to Billy Joe — The World We Know — Romantic Soul — Massachusetts — The Last Waltz — Yesterday — The Soul Goes On — Spanish Eyes. Club members should investigate this one. (H.A.T.)

★ ★ ★

**SWEET SOUL—King Curtis. Atlantic Records (Festival). Stereo SAL-932971. (Also in mono.)**

Interest: Rhythm-and-blues saxophonist.
Performance: Dull.
Quality: Some tape hiss.
Stereo: Fairly well balanced.

This King Curtis album was one of a batch of "soul" albums with which Festival recently flooded the market. Unfortunately, it is nowhere near the standard of some of these other albums by artists like Aretha Franklin, Otis Redding and Arthur Conley.

King Curtis, a Texas-born alto, tenor and soprano saxophonist, has been on the periphery of jazz for many years, but he is best known as a rhythm-and-blues musician.

Unfortunately his talents as a creative soloist are somewhat modest. However, this album was doomed to mediocrity from the start by the unimaginative choice of material. Instrumental performances of songs like "By the Time I get to Phoenix," "Honey" and "Dock of the Bay" tend to be dull. These versions are no exception, largely because Arif Mardin's arrangements are disappointingly poor for one so talented.

Despite the presence in the backing group of excellent musicians like Frank Wess (tenor), Joe Newman (trumpet) and Benny Powell (trombone) — all former members of the Basie Band— the overall sound lacks any real personality.

The limited playing time of 28 minutes is, in this case, a distinct advantage! (T.F.C.)

★ ★ ★

**LATIN GUITAR. Tony Mottola, guitar. Universal Record Club Stereo U-925.**

Interest: Mottola plays Latin American.
Performance: Smoothly swung.
Quality: Excellent.
Stereo: Good spread.

Originally released as one of Enoch Light's Project 3 recordings last year, this disc has now been made available through Universal Record Club. As the title implies, the Latin American styles are used throughout, regardless of the origins of the tunes. Represented in the selection are, besides the inevitable bossa nova, the beguine, samba, tango, bolero and paso doble. Backing for Tony Mottola's smoothly played guitar lead is provided by a very accomplished group, comprising Phil Bodner, flute; Dom Cortese, amplified accordion; Al Casamenti, electric guitar; Gene Bertoncini, rhythm guitar, Bob Haggart, bass; Bobby Rosengarten, drums; and Phil Krauss playing vibes, marimba and "vibraslap." The arrangements are in line with the usual high standard of Project 3, so is the sound quality and stereo spread. Mottola fans will not be disappointed.

Somethin' Stupid — I Will Wait for You — Lush and Lovely — How Insensitive — I Cover the Waterfront — Guantamera — The World of Your Embrace — Spanish Harlem — Dream Theme from "Act I" — Samba de Orfeu — La Montana — What Now My Love? (H.A.T.)

★ ★ ★

**AMBERWREN AND OTHER FOLK SONGS. Lionel Long, vocals, with Don Andrews, guitar, and Wally Wickham, bass. Encore (E.M.I.) Stereo SOEX 9448.**

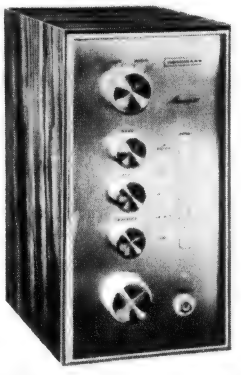
Interest: Australian folk singer.
Performance: Pleasing style.
Quality: Well recorded.
Stereo: Normal.

Amberwren is the title of the folk song which takes up the whole of side 1 of this disc, and must be the longest folk song ever recorded. It is strophic in form, and although I did not count the verses I imagine there must be close to forty. The delicate imagery

# HIGH FIDELITY

## THE name is

# GOODMANS



**MAXAMP 30** is a fully transistorised stereophonic High Fidelity Amplifier using Silicon Transistors throughout. It is precision engineered and fullest use is made of printed circuits. It will deliver continuously up to 15 watts of power on each channel and it looks as good as it is. Its polished wood cabinet with 'Danish Silver' scratchgrain control panel blends with any decor.

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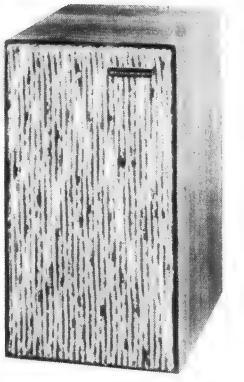

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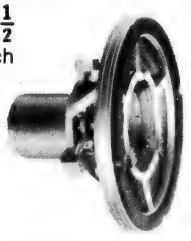
8"—6 watt

**$9\frac{1}{2}$ inch**

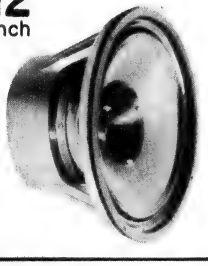


**AXIOM 80**
$9\frac{1}{2}$"—6 watt

**AXIOM 10**
10"—10 watt

**10 inch**

**12 inch**

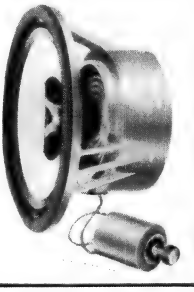


**AXIOM 201**
12"—15 watt

**AXIOM 301**
12"—20 watt

**TRIAXIOM 1220c**
12"—20 watt

**TRIAXIOM 212c**
12"—15 watt



Each of the six loudspeakers in this range covers the full audible frequency range, and mounted in an enclosure of the correct design each is a complete High Fidelity system. There is a unit to suit every requirement—amplifier output, room size, pocket and personal taste—from the economical Axiette 8 and TwinAxiette 8, through the more powerful Axiom 10 and Axiom 201, the Axiom 301, the world's most advanced twin cone 12" speaker, to the connoisseur quality hand-built Axiom 80 transducer and the triple element Triaxiom 1220c and 212c with built-in Treble control.
If you choose an Axiom 201, 301 or 10, the unit's performance can be further enhanced, if desired, by the later addition of Trebax High Frequency and Midax Mid-range units.

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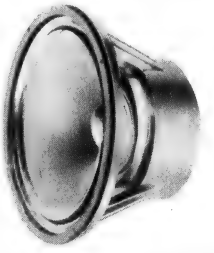
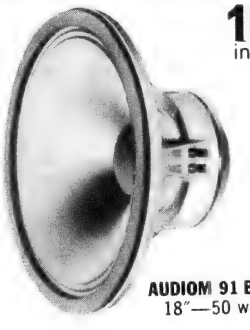


**AUDIOM 51 BASS**
12"—15 watt
**AUDIOM 61 BASS**
12"—20 watt

**15 inch**

**AUDIOM 81 BASS**
15"—25 watt

**18 inch**



**AUDIOM 91 BASS**
18"—50 watt

**Standard Versions** of all Audiom speakers are available for Public Address work and Musical Instrument amplification (Electric guitars etc.)

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For a very low distortion, high sensitivity loudspeaker system choose a Goodmans 3-way system, employing an Audiom Bass unit, and pressure-driven horn-loaded Midax mid-range and Trebax high frequency units, with crossover network and attenuators.

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Range: 2,500-20,000 c/s. 25 watt

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Complete with XO and attenuator. Range: 2,500-20,000 c/s. 20 watt

**MIDAX 650**
Range: 650-8,000 c/s. 25 watt.

**XO/950/5000**
Crossover frequencies: 950 and 5,000 c/s.

**XO/950**
Crossover frequency: 950 c/s.

**XO/5000**
Crossover frequency: 5,000 c/s.

**ATTENUATOR**
8-step

● Impedance of each speaker is 15-16 ohms, unless otherwise stated.

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of this song has made it a firm favourite in my household since the original release two years ago. It tells the tale of a fair princess of long ago who became dissatisfied with her lot and wandered the world seeking the answer to a riddle, only to find too late that the riddle merely pointed out that youth is ephemeral. In other words, don't spend your life looking for answers when you should be enjoying your youth.

Side two has six shorter songs, including two by Long himself ("I Dreamed of Two Ships," "Two Doves"), Bob Dylan's "Farewell," a protest song by Gordon Tolman entitled "Namatjira," the very popular "Turn, Turn, Turn" of Pete Seeger and an arrangement of the traditional "Boll Weevil." A good varied program, nicely sung by Long, and one which folk song enthusiasts should investigate at the $2.50 Encore price tag. (H.A.T.)

★ ★ ★

**NOBODY ELSE BUT ME. Tommy Leonetti. Orchestral arranger and conductor, Frank Hunter. Stereo, RCA LSP-2962. Also in Mono.**

**TOMMY LEONETTI Sings The Winners. Orchestral arranger and conductor, Claus Ogerman. Stereo, RCA LSP-3404. Also in Mono.**

**TOMMY LEONETTI — Trombones, Guitars and Me. Arrangements by Sid Fellen; Orchestra conducted by Van Alexander. Stereo, RCA LSP-3543. Also in Mono.**

Interest: Singer, TV personality.
Performance: Very smooth, very capable.
Quality: Good.
Stereo: Normal.

With Tommy Leonetti making quite a hit as compere of TV Channel 7's Sydney Tonight, RCA can hardly miss with these albums, recorded in New York and Hollywood. With experience as a big-band soloist, concert artist, in recording and TV studios, and in musicals, T.L. can handle a wide range of styles smoothly and and comfortably, without having to rely on electronic gimmickry.

This versatility is stressed in "Nobody Else But Me" which, from the serial numbers, one would judge to be the first of the three to be recorded. It features: Joey — She's Just Another Girl — I'll Get By — Bye Bye Blues — A Beautiful Friendship — One Night Stand — Nightingale In Berkeley Square — I'll Be Around — Nobody Else But Me — She Was Too Good For Me — You're My Girl — Wagon Wheels.

In "Sings The Winners" the theme is that good recent songs — like good old songs — never die. The arrangements by Claus Ogerman have a Latin-American touch and the sound is just a little cleaner overall. The "Winners" include : Spanish Harlem — So Much In Love — The Wayward Wind — Looking Back — Save The Last Dance For Me — Personality — Wonderful! Wonderful!—Moments to Remember — Come Softly To Me — Our Day Will Come — I Can't Stop Loving You — Oh, Lonesome Me.

In "Trombones, Guitars and Me" the backing is different again, but effective nevertheless. This one contains: Of Thee I Sing — The Sweetheart Tree — What Now, My Love — The Shadow Of Your Smile — Softly As I Leave You — I'm Taking You With Me — Moment To Moment — Quiet Nights Of Quiet Stars — Jack, Go Back To Jill — I Love You Today — Street Where Old Friends Meet — Walkin' My Baby Back Home.

Of the three, I marginally preferred "Sings The Winners," but there's not that much to choose between them that you shouldn't buy on the basis of the titles that you happen to like. (W.N.W.)

★ ★ ★

**BELAFONTE ON STAGE. Harry Belafonte with orchestra and chorus conducted by Howard Roberts. RCA Stereo SL101821. Available in Mono.**

Interest: Folk.
Performance: In serious mood.
Quality: Fine.
Stereo: Good spread.

The title says "on stage" and I suppose this is meant to be taken literally, and that these tracks are from a live performance. If this is the case, the audience is strangely quiet, and the applause at the end of each item is brief and lukewarm, which one would not expect from a Belafonte concert.

The program is rather serious in style. "Look Over Yonder" was sung by chain gang convicts, but in this version Belafonte has added some wryly humorous verses entitled "Be My Woman, Gal." "Glory Manger" has a Christmas theme, and "In My Father's House" is based on an old hymn. "Try to Remember" is from the musical "The Fantastisks"—it has a particularly appealing melody. The other tracks are fairly standard folk songs, either traditional or modern: Shake that Little Foot — Windin' Road — Hoedown Blues — Why 'N' Why — Contemporary Dance. Not one of Belafonte's best efforts. (H.A.T.)

★ ★ ★

**WONDERFULNESS. The Amazing Comedy of Bill Cosby. Stereo, Warner Bros. WS-1634. Also in Mono W-1634.**

Interest: Popular entertainer.
Performance: At his best.
Quality: Excellent.
Stereo: Spreads the audience.

About 12 months ago, I spent an hour one evening in a friend's home in Philadelphia chuckling over one of Bill Cosby's then recent releases. The trouble was that, when I came to look for the record later, I couldn't remember the title.

Well, here it is, just released in Australia, and it's a beauty. On side 1, Bill takes 15 minutes to describe his reactions, as a small boy, to a tonsil operation. Then he reminisces about the children's playground provided by the adults in his district, about lumps in his porridge and about go-karts—subjects all pretty close to our own childhood recollections.

On side 2 he relives the experience as a scary kid, listening to horror shows on the old Philco radio. Remember "Inner Sanctum"? Three other tracks round off a thoroughly enjoyable performance.

If you've been on the lookout for a clean, funny-ha-ha disc for those odd occasions, I doubt if you'll find a better one than this. (W.N.W.) ■

# TUDOR RADIO

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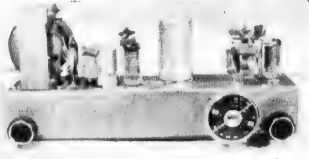
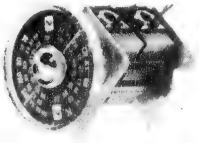
MSP Electro Dynamic, 8in, $4, or 6 x 9.
MSP 6 x 2 15 ohm, **$3.**
MSP 6 x 4 15 ohm **$3.50.**



**RADIOGRAM CHASSIS** 4 valve including valves and speaker, $15.50. Size 10½ x 3 x 5.



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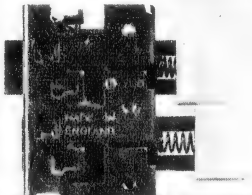

**English push-button on/off switches, 75c each. Pack and post 10c.**

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Scope soldering iron, standard; mini scope. Scope De Luxe. Vibra scope; National scope transformer.

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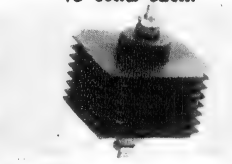

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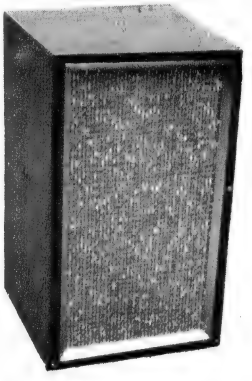

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**Fuse holders** ..... 50 cents doz.
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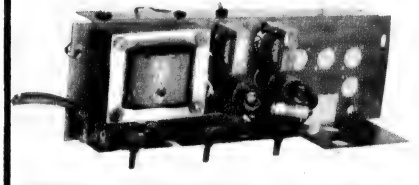
**M.S.P. 6in SPEAKERS, 3 or 15ohm** .. .. .. .. .. .. .. .. **$4.00**

**6 VOLT PILOT LIGHT, screw-in** .. .. .. .. .. .. .. .. **ea. .10**

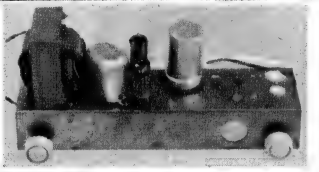
TRANSISTOR speaker and Case Plastic 5-inch speaker with plug and lead, $4 each. Pack and Post 25 cents.



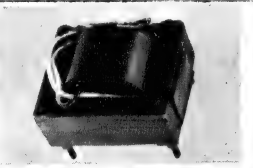
**STEREO AMPLIFIER, 3½ watts per channel** ..... **$19**

**TV Portable voltage doubler power trans. C. Core. 240 volt 77V 1 amp. 6.3 Volts 8 amps, $6.**

**TV POWER TRANSFORMER, $8.** 300 mil. Two 6.3 windings. 200 volt secondary for Bridge Type Rectifier.

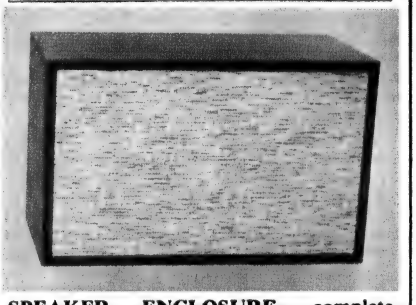


**AMPLIFIER,** 3-watt, complete with speaker. Size 10½ x 3 x 5. **$11.** Pack and post, 75c.

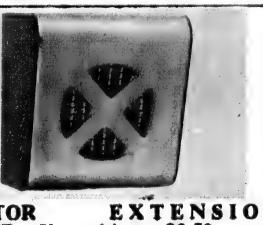


**VOLTAGE DOUBLER POWER TRANSFORMER.** 200 mil 240 volt x 105-110 secondary 6. 3V 15 amp. **$8.**

**BATTERY SAVER.** 6 or 9 volt DC 100MA, **$8.50**; 300 MA, **$10.**



**SPEAKER ENCLOSURE,** complete with 8in M.S.P. dual-cone speaker, 8 or 15 ohm, **$15.80.**
Cabinet without speaker, **$10.**
Cabinet size 16 x 10 x 8.



**TRANSISTOR EXTENSION SPEAKER.** 5in cabinet, **$3.50.**

# SPECIALS

**TRANSISTOR AUDIO TRANSFORMERS,** medium size .. 75c each
**PHILIPS GRAMOPHONE MOTOR.** 4-speed. New. 6-volt ..... **$5.00**
Pack and post, 10c.
**TRANSISTOR OUTPUT AND DRIVE TRANSFORMERS.** Medium size, **$1.50** pair.
Pack and post, 10c.
**SPEAKER TRANSFORMERS,** 5,000 to 8 ohms 10 watt ..... **$1.90 each**
Pack and post, 20c.
**DYNAMIC MICROPHONES,** good quality ..... **$7.50**
**8-STRAND WIRE ONE SHIELDER,** 20c per yard.
**CARAVAN TV AERIALS** .. **$10.50**
**SILICON DIODES** 210 3254G HR15, 75c each
**CAR RADIOS,** new push-button transistor 8 ..... **$50.00**
Pack and post, 50c.
**CABINET CLOTH,** best quality, 50c sq. ft.
**ELECTROLYTIC CAPACITORS.** 20, 400, 450, 10, 400, 450 ..... **$1.50**
50, 65 ..... **50c each**
Pack and post, 10c.
500, 10VW, 12VP ..... **30c**
400 MFD, 10V ..... **30c**
00.5MFD, 2000 DD.CW HERMSCEAL, 20c
**TRANSISTOR SPEAKER TRANSFORMERS,** 500 to 30 ohm .... 50c
Pack and post, 10c.
**TRANSISTOR CHOKES,** 2 ohm 50c
Pack and post, 10c.

**NEW RADIOGRAM,** chassis, mono, complete, valves, speaker .. .. **$13.50**

**POTS**

1 meg. Dual Ganged Log. .. .. **$1.25**
1 meg. Dual Ganged Lin. .. .. **$1.25**
½ meg. Switch Pot double pulled log .. .. .. .. .. .. .. .. 75c
2 meg. Lin. Pots .. .. .. .. .. 50c

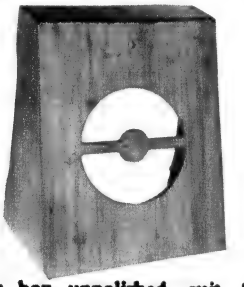
**GARRARD,** 32 volt, 3 speed record changer .. .. .. .. .. .. .. .. .. **$15**

**TRANSISTOR 8 RADIOGRAM CHASSIS**

Complete except pots and Ferrite Aerial. Famous make. .. .. .. .. .. **$18**

**STEREO SPEAKER LEAD,** 8 Cents yd.

**GARRARD MAGAZINE TAPE DECK** ¾ Per Second, 2 Track, Left to Right **$25.**



**Speaker box unpolished suit 8 inch speaker $3.75. Pack and post 50 cents.**

2N 1108, 2N 1110, 2N 1111, Transistors **50 Cents** each.

**RCA VIBRATING CAPACITOR.** 98601 .. .. .. .. .. .. .. .. .. .. .. **$2**

**Dial scales, 5in 11½ x 6, 10½, 3½, 9¾ x ¾** .. .. .. .. .. .. .. .. **50c**

**Pots 50 ohm switch, .... 50 cents each.**

**American or Japanese 2 pin power plugs rubber complete with 2½ yards flex 50 cents,** Pack and post 10 cents.

**Microphones magnetic or crystal $1.75.** Pack and post 10 cents.

**New pocket size transistor 6 radios in presentation case $20.00.**

Magnavox 8 WR, 10 WR, 12 WR. Tweeter 3, 4 or 5 inch

**Speaker Plugs, 4 pin .. .. .. 15 cents**
**Speaker Sockets** .. .. .. .. .. **15 cents**

**PUSH PULL AUDIO TRANSFORMERS** 10,000 CT 3.5 ohm .. **$3.00** each

**STEREO HEADPHONES, $10** pair. Pack and post 25 cents.

**TRANSISTOR DRIVE and OUTPUT TRANSFORMER** 23 to 15 ohm. 75 cents a pair.

Size 5 x 6 x 3 TRANSISTOR speakers in Cabinet wood polished $4 each. Complete with plug and lead. PACK and POST 25 cents.

Mullard Bookshelf Speaker Cabinets $10 each.

**STEREOGRAM CHASSIS,** 5 watt per channel, complete except speakers. $35

**NEW POSTAGE RATES PLEASE ADD EXTRA**

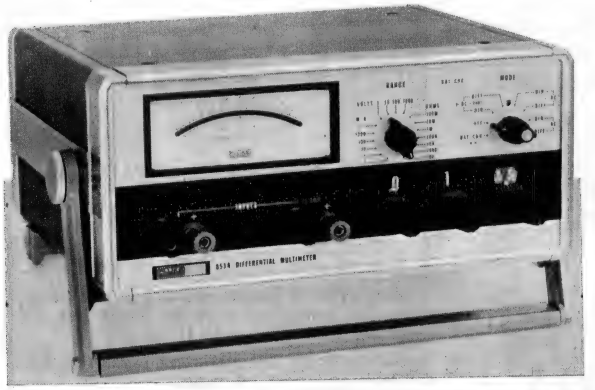
# TRADE REVIEWS AND RELEASES

## FLUKE HIGH ACCURACY MULTIMETER

**Recently announced as an addition to the high-quality measuring instrument range manufactured by the American firm John Fluke Mfg. Co. Inc. is a compact high-accuracy portable multimeter. Designated the type 853A, it offers a DC/ohms accuracy of 0.2 per cent and an AC acuracy of 0.5 per cent—together with full overload protection.**

The Fluke 853A measures a compact 11¼in x 5¼in x 9in, and weighs approximately 10lb. It is fully solid-state, and operates either from the AC mains or from an internal battery. The instrument provides a total of 27 measuring ranges, covering DC voltage and current, AC voltage and current, and resistance; in each case offering the alternatives of either direct or "differential" (potentiometric) operation.

In the past, differential-mode measurements have been confined almost completely to laboratory situations, and have involved very costly and somewhat static precision instruments. By incorporating this type of measurement facility into the 853A, together with appropriate protection circuitry, Fluke have provided the development engineer, service technician and quality control engineer with a low cost multi-purpose instrument capable of making reliable, precision measurements not only in the protective confines of the laboratory, but also in the relatively harsh environments involved in production testing and work in the field.



*Compact and self-contained, the Fluke 853A combines high accuracy with ruggedness and modest cost.*

When used in the conventional "direct" mode of operation, the instrument performs and is operated in a very similar fashion to any higher-quality multimeter. There are four voltage ranges on both DC and AC covering the FSD range 1-1,000V, six current ranges (again for both DC and AC) covering the FSD range 100uA-10A, and seven resistance ranges covering the FSD range 100 ohms-100M. Separate input terminals are used for the two 10A current ranges.

Of particular note from the point of view of reading convenience and freedom from ambiguity is that the 853A meter face is fitted with but a single "direct" measurement scale, calibrated 0-1.0. All readings on the various direct ranges are made on this scale, the ranges being stepped in decade ratios while the resistance ranges employ the "constant current" measuring system, which allows them to use the same linear scale.

Accuracy of the instrument in the direct mode is plus or minus 2 per cent of full scale on the current and voltage ranges, and plus or minus 3 per cent of full scale on the resistance ranges. Input resistance on the DC voltage ranges is 11 Megohms, and on the AC voltage ranges is 1 Megohm; voltage drop on all current ranges varies from 100 to 300mV.

In the differential mode of operation the meter circuitry of the instrument becomes a balance or null indicator, registering the degree of balance or otherwise between the external quantity being measured and an internal reference whose amplitude is controlled by the operator using three control dials. The "decile" and "centile" controls are of the switch type, while the third control is a potentiometer whose dial is calibrated in units representing .01 per cent of FSD for the range in use. Resolution of the instrument in the differential mode is, therefore, approximately 100 times that in the direct mode. Ranges in the differential mode are the same as in the direct mode, but the range of the internal reference dials is such that all ranges are effectively provided with 10 per cent over-ranging.

Instrument accuracy in the differential mode is plus or minus (0.2 per cent of reading plus .02 per cent of range FSD) on DC voltage and lower current, plus or minus (0.5 per cent of reading plus .02 per cent of range FSD) on DC voltage and lower current, plus or minus (0.5 per cent of reading plus .05 per cent of range FSD) on 10A and on AC voltage and current from 30Hz to 20KHz, and plus or minus (0.2 per cent of reading plus .01 per cent of range FSD) on the resistance ranges below 10M. Above 10M the accuracy is plus or minus 0.5 per cent of reading. Input impedances and voltage drops of the instrument in the differential mode are identical to those in the direct mode.

In both the direct and differential modes the instrument is fully protected against overload. Rated overload capacity on all voltage ranges is 1,200V RMS; on the 10A ranges, 12A RMS; on the remaining current ranges, 2A; 120V RMS on the three lower resistance ranges, and 230V RMS on the upper resistance ranges. The instrument itself is rated as incapable of causing damage to typical semiconductors during any measurement.

The specified calibration stability of the instrument is that it will remain within the foregoing performance figures for 12 months without internal adjustment. Operating temperature range is 10-40 degrees C within specifications, with a derating of 100ppm per degree C beyond these limits to 0 and 55 degrees C. Relative humidity ratings are 80 per cent to 35 degrees C and 70 per cent to 40 degrees C. The performance of the 853A under conditions of shock and vibration meets the requirements of MIL-E-16400F.

Power consumption of the instrument itself is approximately 3 watts. In the form normally supplied it operates from 115/230V plus or minus 10 per cent, 50-500Hz, or alternatively from a 22.5V zinc-carbon battery (life approximately 80 hours). Provision for operation from a rechargable nickel-cadmium battery is an option, the instrument in this case drawing approximately 6W from the AC mains when battery charging is in progress.

Tested in our laboratory the sample 853A instrument pictured gave a most impressive account of itself. Performance and operating convenience were both outstanding for a portable multi-purpose instrument, and the accuracy and stability appeared to be well within the specifications. Even intentional overloads failed to ruffle its metrological aplomb; the only effect we could produce being a blown fuse, which temporarily disabled the lower current ranges.

In short, we found the instrument virtually all that one would wish. It is sturdily made, appears to be the product of considerable design thought, and gives every evidence of being well capable of making reliable and accurate measurements in a wide variety of situations. These qualities together with its portability, flexibility and modest cost, should make it of considerable interest to all who must make measurements of greater precision or reliability than average.

Price of the Fluke 853A Differential Multimeter is quoted at $465. All inquiries regarding the instrument should be directed to the sole Australian representatives for Fluke, Elmeasco Instruments Pty. Ltd., of 41 Carter Road, Brookvale, N.S.W., 2100 (J.R.).

## I-C AUDIO AMPLIFIER

A complete audio power amplifier in monolithic integrated form has been introduced by Philips Components Group. Known as the TAA-300, it incorporates special measures to prevent cross-over distortion throughout a wide range of supply voltages (4.5 to 10V) and is capable of delivering 1W output into an 8-ohm load. The input signal for an output of 0.7W is typically 7mV, while the input impedance is 15K. The total distortion with an output of 0.5W is less than 3 per cent. Inquiries to Miniwatt Division, Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W., 2064.

# A SIGNAL SOURCE FOR TV SERVICING

**Standard Components Pty. Ltd., specialised television parts wholesalers, have recently developed and released the compact servicing instrument pictured. Called the "Telestrobe" Bar Generator, the unit generates signals suitable for testing most stages in the video and audio sections of a receiver.**


The Telestrobe measures only 4¼in x 3¼in x 2in, weighs a mere 20 ounces and is suitable for use either on the bench or in the technician's tool kit. It is constructed in a sturdy cast aluminium alloy case, and is designed to withstand rough handling. Power consumption is a modest 50 milliwatts, supplied by an internal 9V battery.

The unit employs four silicon transistors and consists of a 300Hz multivibrator together with a tuned RF oscillator; the idea is that the two provide signals capable of injection into almost any part of the video/audio chain of a receiver to produce either a symmetrical horizontal bar pattern on the kinescope screen, or a 300Hz tone from the loudspeaker.

The RF oscillator may be switch-tuned to 10 of the VHF television channels, to the vision IF of 36MHz or to the sound IF of 5.5 MHz. At each frequency it is modulated by the 300Hz squarewave from the multivibrator, with the appropriate FM for the 5.5 MHz signal and AM for the remainder. The modulated RF output is available at four alternative output sockets, with 20dB amplitude ratios to permit gain checking: 200mV, 20mV, 2mV and 200uV. Vernier fine tuning is provided by means of a front-panel potentiometer and a variable-capacitance diode, giving ±2MHz on the VHF ranges and ±1MHz for the video IF range.

In addition to the modulated RF output, the multivibrator signal is made available separately for testing the audio and video amplifier sections. The output amplitude of this signal is adjustable by means of a potentiometer, which is combined with the instrument power switch. This output is also suitable for trouble-shooting in standard AM broadcast receivers and audio amplifiers, as the squarewave is quite rich in harmonics.

A "battery test" point is provided on the front panel of the instrument, the acceptable voltage range being 4-9V. The Telestrobe is supplied complete with an "RF" output lead fitted with a balun giving 300 ohms unbalanced output, and an "IF-Video-Audio" lead fitted with a 400V isolating capacitor. Also provided is a concise instruction manual.

We understand that units available by the time this notice is published will also feature an adjustable 0/-9V bias supply for AGC testing, although the sample pictured and sent to our laboratory for review was an early production unit and did not include this facility. Together with the additional function will be an appropriate pair of bias clip leads.

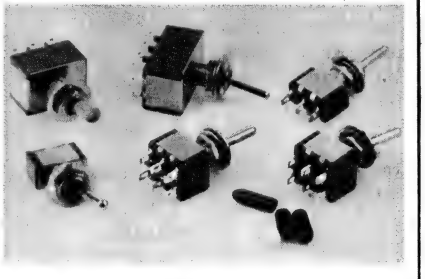
Tested in our own laboratory and also "in the field" by an independent TV servicing company, the sample Telestrobe performed very well. It delivered clean signals on all ranges, proved convenient and stable in operation, and gave every impression of being a very useful and reliable servicing aid.

Price of the unit is quoted as $50, plus 15 per cent sales-tax. It will probably be up to each individual service technician to evaluate the likely worth of the unit to himself, taking the cost into account together with the nature of the servicing jobs undertaken and the techniques normally employed.

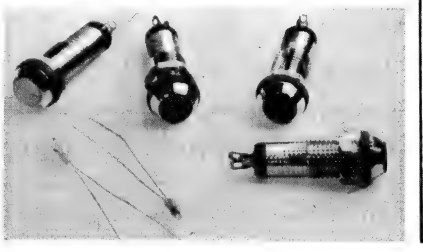
Inquiries regarding the Telestrobe Bar Generator may be directed to Standard Components Pty. Ltd. at 10 Hill Street, Leichhardt, N.S.W. 2040. (J.R.).

# MINIATURE COMPONENTS FROM DUCON

Ducon Division of Plessey Pacific has available a range of sub-miniature toggle switches manufactured by C. & K. Components Inc., U.S.A. The switches available as SPDT, DPDT, 3PDT or 4PD, feature rugged construction and simple mounting. Contact rating is 5A, resistive load, at 115V AC or 28V DC. Minimum insulation resistance is 1000M and initial contact resistance is 10 milliohms at 24 V DC, 1A. Minimum electric life is 40,000 cycles at maximum rating, resistive load. Short toggle assemblies are available also switches with long toggle levers. Caps in various colours can be supplied at no extra cost.



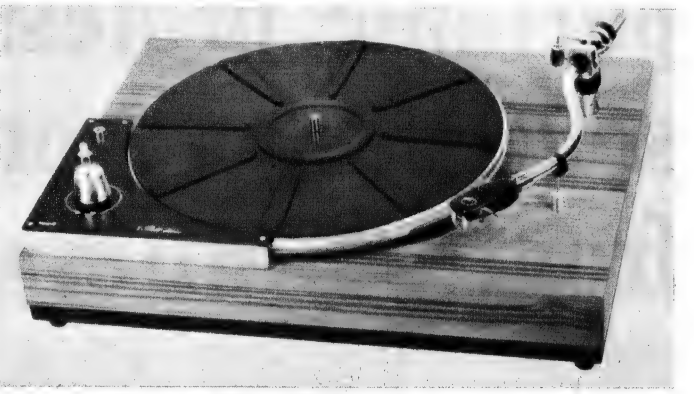
Ducon also stock a range of subminiature and indicator lamps manufactured by Okaya Electric Industries Co. Ltd., Japan. The subminiature lamps, rated form 5 to 48V, come in three basic configurations with wire or flanged terminations. The indicator lamps, in two models, are rated at either 6.3V 50mA or 14V 30mA with various lens colours.



Inquiries should be directed to Ducon Division, Plessey Pacific Pty. Ltd., P.O. Box 2, Villawood, N.S.W. 2163.

# NEW RECORD PLAYING EQUIPMENT FROM ENCEL ELECTRONICS

Pictured is an interesting combination of audio components from Encel Electronics (Stereo) Pty. Ltd. They are the Compax 111 2-speed turntable, the Nikka-Lustre ST-510 tone arm and Micro VF-3100/e magnetic cartridge. They give good performance at a very reasonable price.



The Compax turntable has a pressed aluminium platter which is belt-driven by a 5-watt 12-pole synchronous motor. The platter revolves on a hardened and accurately ground spindle, ¼ inch in diameter. The motor is flexibly mounted to the diecast baseplate and is fitted with a double pulley, which drives the very flexible latex rubber belt.

Two speeds are provided — 33 and 45 rpm — which are the only ones really necessary these days for high-quality sound reproduction. Speed change is performed by a knob which is pushed and twisted through 330 degrees to select the desired speed. The knob is coupled to a cam which lifts the belt from one section of the pulley to the other. Quite ingenious!

Pulley diameters are arranged so that they provide speed within close tolerance when using a pick-up at 2 grams. The turntable takes about one revolution to reach full speed. Switch on and off is achieved by a push-on/push-off switch and a neon bezel indicates when power is applied.

The platter is 12 inches in diameter and is fitted with a special rubber mat which is claimed to have anti-static properties. The mat is radially ribbed which makes for easy cleaning. One small point that we did not like was that the centre-hole of the mat was too large, so that it seems invariably to end up off-centre, as it isn't glued down.

The turntable assembly is very compact, overall dimensions being 13¼ inches by 12½ inches with depth below the top of the mounting board only ¾ inch. Overall appearance is good.

In operation, the unit performs very well. The claim of 0.04 per cent, wow and flutter would appear to be true. We attempted to measure rumble using the arm and cartridge supplied and found it to be submerged below record surface noise and impossible to measure without the use of filters. Under normal conditions rumble cannot be detected with bass and volume controls fully advanced — acoustic feedback will set in first. The low motor speed (500 rpm), mechanical isolation of the motor from the baseplate and belt drive are certainly very effective in eliminating rumble.

The turntable is, however, not completely quiet in operation. A "tinkling" noise, if readers will excuse the description, is emitted by the platter as the belt engages and disengages the rim. This purely acoustic noise is heard only in very quiet locations and when records are not actually being played. We make this observation so that readers will not expect a completely silent turntable. It is very quiet, but not completely silent.

The Nikka-Lustre ST-510 tone arm is a double-curved arm with a number of interesting features. While having eye-appeal, the double-curve achieves the required head offset for minimum horizontal tracking error and places the anticipated centre of gravity of the head in line with the pivot and counter-weight.

The head-shell has the EIA standard locking collar as used on SME, Ortofon and Garrard equipment. The head-shell will take all cartridges with the standard ½in mounting centres and has a range of adjustment for stylus overhang. Unfortunately the adjustment can only be done with the cartridge out of the shell — the mounting plate is slid up or down and locked with a nut, making adjustment a trial and error affair.

The locking collar socket in the arm can be twisted and locked in position with a screw to ensure that the cartridge is oriented correctly in relation to the record surface.

Adjustable weights are provided for balancing in the vertical and horizontal planes, the main counterweight being locked in position by an expanding sleeve. The tracking weight is adjustable from 0 to 2½ grams by a calibrated rotary section of the counterweight which slides the assembly forward or back. It is a pleasure to use. Adjustment for height is also provided.

The arm is supplied with a connecting cable with RCA phono plugs and 5-pin plug which connects to the socket in the base of the arm. The arm has low bearing friction and will track well at stylus pressures below 1 gram. It would appear to be very good value for the price. It is supplied complete with mounting template, spanner and small screw-driver.

The Micro VF3100/e cartridge apparently operates on the "induced magnet" principle, according to the manufacturer's literature and to judge by the appearance of the stylus assembly, which is easily removeable. The cartridge is finished in beige, with a red stylus assembly and weighs 7.5 grams. It has the usual ½-inch mounting centres. The output terminals are clearly marked.

The claimed performance of the cartridge is as follows: Frequency response 20Hz-28KHz. Separation at 1KHz 28db. Compliance (at 100Hz) 9 x $10^{-6}$ cm/dyne. Sensitivity 5mV at 5cm/sec. Tracking weight 1.0-2.5 grams. Load 50-100K. Stylus radii 0.3 x 1.0 mil.

The cartridge is also available with a 0.5 mil conical stylus which gives somewhat reduced tracing performance but probably a marginally longer wear-life.

Frequency response and separation between channels was checked using the CBS STR-100 test record and the Hewlett-Packard HP331A distortion analyser as a precision AC millivoltmeter with a load of 47K. Tracking weight was set at 2 grams. The frequency response checked out at plus or minus 2dB from 30Hz to 20KHz.

Separation between channels was very good at 33dB at 1KHz and never less than 38dB over the range from 500 Hz to 20KHz. This is very good performance indeed.

The waveform over the most of the audio range was good. On "square waves," as recorded on the CBS STR-110 record, the cartridge performed well, with only slight ringing.

We found that a stylus pressure of 1.5 grams was desirable for most records. The cartridge gives a clean, well-balanced sound with, as could be expected from the separation figures, a sharply defined stereo image. At 2 grams, it tracked the 12dB band of the W and G 25/3434 test record quite comfortably, while at 2.5 grams it tracked the +16dB band with only slight embarrassment.

All the above units can be purchased separately, or in combination. Compax turntable sells for $39.50, the teak base being $10 extra. The Nikka-Lustre ST-510 arm is priced at $19 and the Micro VF3100/e sells for $29.50.

Enquiries should be directed to Encel Electronics (Stereo) Pty. Ltd., 431 Bridge Road, Richmond, Victoria, or 257 Clarence Street, Sydney, N.S.W. (L.D.S.)

# Now... a completely portable, professional quality, solid-state recorder from Tandberg


## The new Tandberg Series 11!

Simon Gray proudly introduces a completely new, efficient, portable recorder from the world's leading manufacturer of high-fidelity recorders . . . the TANDBERG organization. TANDBERG SOUND has become an international symbol for reality and natural sound reproduction . . . the sound of TANDBERG quality is unmistakable. The "Series 11" is no exception.

The "Series 11" is a battery-driven monaural recorder designed for professional and semi-professional use. Three speeds are featured — 7½, 3¾ and 1⅞ i.p.s. Operation is simple . . . the one control selects fast forward, rewind and normal drive for recording or playback. Push buttons are used to select recording or playback modes. Recording level is indicated precisely on a VU meter. An automatic gain control facility is also incorporated and can be selected when required. Control of recording is very simple; monitoring off the tape is facilitated by three heads and separate record and playback amplifiers. In addition to separate record, erase and playback heads, provision has been made for the addition of a fourth head to permit movie camera synchronisation. Mixing is possible as separate controls are provided for microphone and line inputs. Sensitivity is 5 mV. for the 10 K ohms Low Level input, 100 mV. for the 200 K ohms High Level line input. The microphone input sensitivity is 0.1 mV. at 200 ohms (balanced).

Power is provided by ten standard "D" type 1½ volt cells available in any store. An electronic speed regulator ensures precise speed ± 1% during the entire life of the batteries. An optional AC power supply is available as well as an over-the-shoulder carrying bag, headphones and the popular Tandberg Model TM4 dynamic microphone. For the TM4 a balanced input with an impedance of 200 ohms is provided — a balanced output of 600 ohms may be used for external tape recorders and copying purposes.

The circuit contains 41 transistors and 10 diodes. Frequency response is 30-20,000 Hz. at 7½ i.p.s., 30-13,000 Hz. at 3¾ i.p.s. and 30-7000 Hz. at 1⅞ i.p.s. Wow at 7½ i.p.s. is better than 0.1%. Signal to noise is 58 dB. unweighted. Total weight including batteries is only 11½ lbs. Dimensions are 13" x 4" x 10¼".

The Tandberg "Series 11" accepts 7" spools with the lid open and 5" spools with the lid closed. The performance of this versatile recorder is quite outstanding. Audio quality, signal-to-noise ratio, freedom from distortion and wow . . . these are the features that set the "Series 11" apart, as they satisfy professional standards.

*The Tandberg "Series 11" is available from Simon Gray offices and representatives in all states; it is backed by Simon Gray service facilities throughout Australia.*

SGT12/68

Australian National Distributors:

**Simon Gray Pty. Ltd.**

**Head Office: 28 Elizabeth St., Melbourne Vic. Tel. 63 8101***
**Sydney Office: 22 Ridge St., North Sydney, N.S.W. 929 6816**
**Canberra Office: 31-33 London Circuit, Canberra City. A.C.T. Tel. 496050**

INTERSTATE REPRESENTATIVES:

N.T.: Pfitzner's Music House, Smith Street, Darwin. Tel. 3801
Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. 58 1422
S.A.: Eilco Sales Pty. Ltd., 7-9 Osmond Terrace, Norwood, S.A. Tel. 63 4844
Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. Tel. 25322
W.A.: Athol M. Hill, 613-615 Wellington Street, Perth. Tel. 21 7861

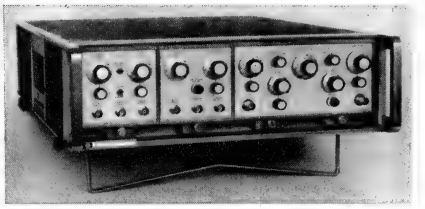
# MODULAR PULSE GENERATOR

A pulse generating system, introduced recently by Hewlett-Packard, is a multi-form instrument in modular form. It uses plug-in modules that allow a user to select the best combination for his requirements. In addition, modules can be combined to create word generators, pulse shapers, variable time delay trigger generators, and other pulse systems.

The first modules in the system, the 1900 series, include a rate generator, a delay generator and a high-power output module. Together they form a pulse generator capable of supplying 1A pulses into a 50-ohm load at repetition rates from 25Hz to 25MHz with rise and fall transition times from 7nS to 1mS. The system is also adaptable to programmed control.

The rate generator produces pulse trains from 25Hz to 25MHz, and also responds to external triggers at any rate from 0 to 25MHz. It can supply single pulses in response to a front-panel push-button, and also can work in a gated mode, generating pulses only when a gating signal is present.

The delay generator gives output trigger pulses that can be ahead of or later than the drive pulses by 15nS to 10mS. It also works in a double-pulse mode generating two drive output pulses for



each input trigger, with delay between output pairs from 15nS to 10mS.

The output module generates pulses with amplitude controllable from 50mA to 1A, and pulse width from 10nS to 40mS. It generates either positive- or negative-going pulses with less than 2pc overshoot on 10nS transitions. The baseline can be offset up to ±60mA to establish logic or bias levels. There are 11 ranges of rise and fall transition times, the minimum being 7-200nS, and the maximum 10-1000uS.

Future modules include lower - power, lower - cost versions and modules that generate faster rise times, higher repetition rates, and binary - word sequences. Further information is obtainable from Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146.

# *TRADE RELEASES—IN BRIEF*

**AUSTRALIAN GENERAL ELECTRIC PTY. LTD.** has been appointed as the sole Australian distributors for three North American companies.

Dale Electronics Inc., of Columbus, Nebraska, U.S.A., and Toronto, Canada, produces a wide range of metal film resistors, fixed power resistors and trimmer and precision potentiometers in both commercial and military types. Dale is now producing a reliable low-cost arrester for protecting all types of electrical equipment from damage by line surges, lightning strikes, etc. The arrester is claimed to have more sensitivity and speed than the other types of arrester. It will break down below 1800 volts when subjected to a pulse rising at 10KV/uS, and will extinguish power-follow current within ½ cycle.

Electronic Devices Inc., of Yonkers, New York, U.S.A., manufactures a wide range of integral heat sink rectifiers in various bridge configurations with current ratings of 4 to 25 amps and voltage ratings up to 1000. These bridges replace four stud rectifiers and are ready for single hole mounting into industrial circuits. The rectifiers are made of diffused silicon junctions with avalanche characteristics.

Stark Electronics Instruments Ltd., of Ajax, Canada, produces a range of electronic instruments and teaching systems. Complete sets of school laboratory equipment are available for various industrial electroics courses as well as for school physics courses.

Information on the product of these three companies may be obtained from Australian General Electric Pty. Ltd., 103 York Street, Sydney, N.S.W. 2000.

**PRINCETON APPLIED RESEARCH CORPORATION,** New Jersey, U.S.A., has developed a Fourier Analyser, model 102, for spectrum analysis of complex or noisy signals. It will increase the applications of the company's correlation function computers by displaying data on a frequency versus amplitude format to supplement the time versus amplitude output available from the correlator. The analyser provides either the power spectrum (the Fourier transform of the auto correlation) or the cross power spectrum (the Fourier transform of the cross correlation).

Simultaneously available as outputs from the analyser are the cosine transform or real portion of the frequency spectrum, the sine transform or imaginary portion, the amplitude or vector sum, the phase angle of the spectrum, and a signal proportional to the frequency under study. The frequency range of the complete system is from 0.25Hz to 495KHz. The displayed frequency range may be divided into as many as 1000 steps for increased readability. Further details are available from the Australian agents, Tecnico Electronics, 53 Carrington Street, Marrickville, N.S.W. 2204.

**TYREE INDUSTRIES LTD.,** through its subsidiary company, Endurance Electric Pty. Ltd., has negotiated licensing agreements with two Swiss companies, Emile Haefely and Co. Ltd., of Basle, and Sprecher and Schuh Ltd., of Aarau, for the Australian manufacture of specialised high-voltage electrical equipment to their designs. The agreement with Haefely is for high-voltage instrument transformers, including magnetic voltage transformers, capacitive voltage transformers, and combination current and voltage metering units. The agreement with Sprecher and Schuh covers high-voltage current transformers. Production facilities for the products covered by the agreements have been built into the company's new factory under construction at Liverpool, N.S.W.

**AMALGAMATED WIRELESS VALVE CO. PTY. LD.** has available the following RCA semiconductors: 2N5470 RF power transistors for UHF/microwave power amplifiers, microwave oscillators and frequency multipliers, (an application note, AN-3764, is also available for this transistor); CD4003 and CD4003D monolithic silicon ICs, complementary MOS dual D-type flip-flop; CD4004 and CD4004T monolithic silicon ICs, 7-stage complementary symmetry MOS binary counter ripple-carry type; CD4007 and CD4007D monolithic silicon ICs dual complementary pair plus inverter. Inquiries to Amalgamated Wireless Valve Co. Pty. Ltd., Private Mail Bag, Ermington, N.S.W. 2115.

**DISA ELEKTRONIK** is offering a selection of tranducers for measuring pressure, force, displacement, piston-stroke, torsional vibration, and proximity vibration. They all measure mechanical quantities in terms of capacitance. When one of them is connected to the Disa reactance converter, model 51E01, its capacitance becomes a frequency-determining element in an oscillator, whose output will be frequency-modulated by changes in the measured mechanical property. In the reactance converter, the FM voltage is converted to a voltage whose amplitude varies as the measured mechanical quantity changes. The resultant analog output can be evaluated on a meter, recorder or CRO. Information on the Disa products can be obtained from the Australian agents, Andrew Thom Ltd., 261 Broadway, Sydney, N.S.W. 2007.

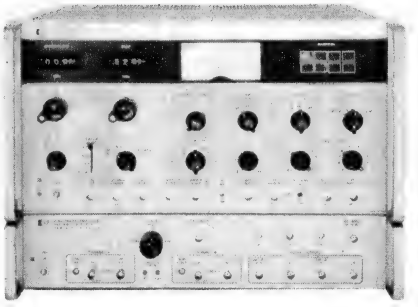
**AUSTRALIAN TELECOMMUNICATIONS DEVELOPMENT ASSOCIATION** has elected Mr Robert Hall, managing director of Plessey Pacific Pty. Ltd., to the Council of the Association. He succeeds Mr F. H. Baker, of Telephone and Electrical Industries Pty. Ltd., who has resigned. The chairman, Sir Samuel Jones, and the other 12 retiring members of the Council were re-elected unopposed.

*Mr Robert Hall*

*Dr Henri Busignies*

**INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION,** of the U.S.A., announced the visit of Dr Henri Busignies, Chief Scientist of the company, to Australia in December, 1968, for discussions on telecommunications matters wtih customers of Standard Telephones and Cables Pty. Ltd., the Australian associate company of ITT. Dr Busignies, a senior vice-president of ITT, has been associated wtih the company for 40 years. As Chief Scientist, he advises ITT management on long-range scientific trends in telecommunications and electronics, and evaluates the probable effect of these developments on the company's business activities.

An inventor and scientist, Dr Busignies holds more than 140 patents in the air navigation, radar and communications fields. He developed a high frequency radio direction finding system, known as "huff-duff," which proved a vital factor in the battle against enemy submarines in World War II. He also invented moving-target-indicator (MTI) radar.



*Hewlett-Packard model 676A tracking detector with a model 675A sweeping signal generator to form a network analyser.*

**HEWLETT-PACKARD COMPANY,** Palo Alto, California, U.S.A., has developed a tracking detector, model 676A, for use with a sweeping signal generator to plot transmission characteristics of filters, amplifiers and other devices. The new detector overcomes the limitations of conventional broadband detectors by using filters to remove signal harmonics and noise, and by using logarithmic amplifiers to increase the dynamic range. It is essentially a tunable, dual-channel, narrow-band filter with detectors to measure the signal amplitude in each channel. Simultaneously, it measures the phase difference between test and reference channels over a 360 degrees range, with resolution as fine as 0.1 degree. Further information from Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Victoria 3146.

**RADIO ENGINEERING LABORATORIES DIVISION (REL),** Dynamics Corporation of America (DCA) has been awarded an order totalling $200,000 for a dual-diversity tropo system in Australia by the Deparment of Civil Aviation. The 48-channel system will include 1KW power amplifiers, FM exciters and receivers, tunnel diode amplifiers and fault indicators. The tropo system will connect Springbrook in Queensland with Point Lookout in N.S.W., and will operate in the 2.5-2.7GHz frequency range. The contract was secured through REL's agents in Australia, Dynamco Electronics Pty. Ltd., 90 Alexander Street, Crows Nest, N.S.W. 2065.

**AMALGAMATED WIRELESS (AUSTRALASIA) LTD.** is now associated in crystal production with one of the world's leading crystal makers, McCoy Electronics. Negotiations are now proceeding for the installation of advanced facilities for encapsulating crystals. The lowest frequency in the present production range of crystals in the Ryde, N.S.W., works is 4KHz; the tope frequency is over 100MHz. In the field of advanced devices engineering, AWA is also concentrating on production of stable unit oscillators, filters and discriminators.

**DUCON DIVISION,** Plessey Pacific Pty. Ltd., has added a miniature linear potentiometer, type WN, to its range of wirewound potentiometers. The dimensions are identical to those of the existing type N Mark 2 moulded carbon track potentiometer. Lead-screw operated, the type WN has a transparent body, and a slipping cluch to avoid over-tuning. The element, wound on a stranded glass fibre core, has a power rating of ½W. The standard resistance range is 10 ohms to 10K with a tolerance of plus or minus 10 per cent. Further information is available from the Professional Components Department, Ducon Division, P.O. Box 2, Villawood, N.S.W. 2163.

**VARIAN** has introduced four series of GaAs oscillators, for use in commercial and military applications, covering the frequency range from 8.0 to 26.5GHz. Each model delivers a minimum CW output of at least 5mW over a 1000MHz mechanical tuning range. The units operate from a single very-low-voltage supply, a characteristic of GaAs oscillators using the Gunn effect. Output is said to be exceptionally noise free. For further information write to the Australian associate company, Varian Pty. Ltd., 38 Oxley Street, Crows Nest, N.S.W. 2065. ■

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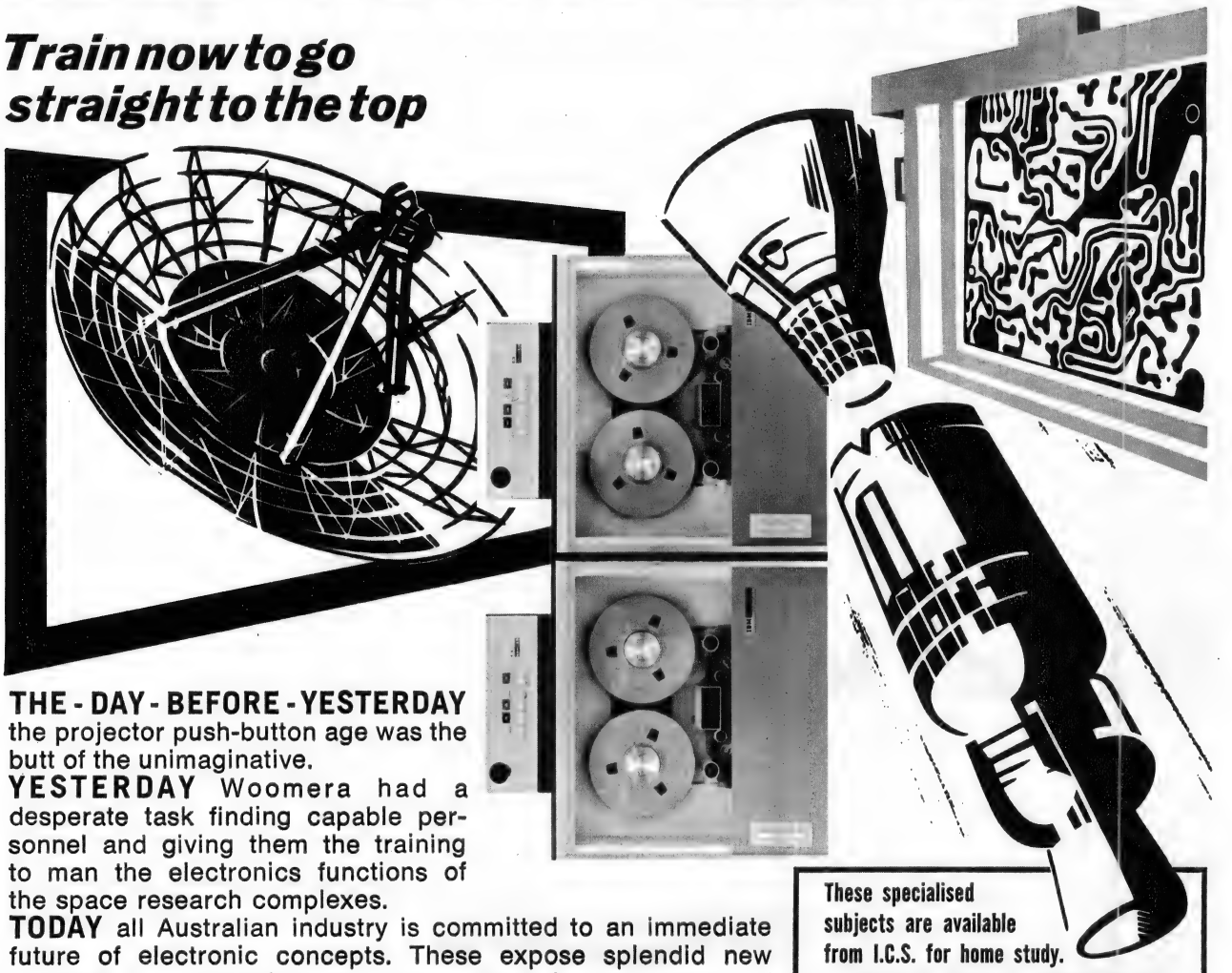

**THE-DAY-BEFORE-YESTERDAY** the projector push-button age was the butt of the unimaginative.

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# TECHNICAL BOOKS AND PUBLICATIONS

## RSGB Handbook . . . "readable, practical"

**THE RADIO COMMUNICATION HANDBOOK, Fourth Edition, Edited by J. E. Tebbit (G3BBY) and A. D. Wiles (G6BBY/T). Published by the Radio Society of Great Britain, 28 Little Russell St, London, W.C.1. Hard covers, 785 pages, 10¾ x 7in. Illustrated with numerous circuits, graphs, photographs, etc., including foldout circuit diagrams. English price 63/.**

This book probably needs little introduction to seasoned amateurs, who have known it for many years either as the R.S.G.B. Handbook or by its more recent title as given above. However, for the benefit of the younger generation, particularly those aspiring to acquire their A.O.C.P., it should be said that this book is a "must". If you can afford only one serious text book at the moment, make it this one.

A major difference between this book and some others in the same class is that it has always placed as much emphasis on the "why" as it has on the "how". This is particularly valuable for the student, who is far more likely to remember a particular fact if he understands the theory behind it.

The first three chapters, Principles, Valves, and Semiconductors, are almost an electronics course in themselves, with a nice balance of the theoretical and the practical. Whether read as preparation for the A.O.C.P. or a broader approach to electronics, they will be equally useful.

Following these first three chapters, the remainder are as follows: (4) HF Receivers. (5) VHF/UHF Receivers. (6) HF Transmitters. (7) VHF/UHF Transmitters. (8) Keying and Break-in. (9) Modulation Systems. (10) Single Sideband Transmission. (11) RTTY (radio-teletype). (12) Propagation. (13) HF Aerials. (14) VHF/UHF Aerials. (15) Noise. (16) Mobile Equipment. (17) Power Supplies. (18) Interference. (19) Measurements. (20) Operating Technique and Station Layout. (21) The R.S.G.B. and the Radio Amateur.

Most of these later chapters are essentially practical ones, in that their ultimate objective is to describe the construction of practical hardware. However, they maintain a nice balance of theory and practice by devoting the first part of the chapter to discussion of basic principles, standards, current state of the art, etc.

For example, in the chapter on HF Receivers, the first part deals with Basic Types of Receivers, ranging from regenerative to synchronous; Performance Requirements, ranging from sensitivity and selectivity to cross modulation and blocking; Front-end Circuits, covering a wide range of RF amplifiers and mixers; IF Amplification, ranging from the choice of IF to mechanical and crystal lattice filters, the latter at some length. Then comes, Detectors; S Meters; Automatic Gain Control; AF Stages; Power Supplies; Transistorised Receivers; and finally, Construction. The foregoing, up to "Construction," occupies over 32 pages.

Construction occupies the remaining 35 odd pages and describes in detail the construction of a simple TRF two-valve receiver; a low-cost superhet four-transistor-receiver; a low-cost high-stability converter, a Q multiplier, a double conversion superhet, and an advanced receiver with a tunable first IF. This last is a most complete design, providing just about every feature one could ask for in an amateur receiver.

For obvious reasons it is impossible to review each chapter in the same detail, even though this was necessarily a brief summary. However, it should give the reader a good idea of the contents of the book as a whole, for it is quite representative. We can only add that each chapter is chock full of readable, practical material which will keep the reader occupied for a long time to come.

In short: Unreservedly recommended.

Our copy came direct from the publishers and there is no indication yet as to the availability and price in Australia. However, it will undoubtedly be available from the larger bookstalls, at least to order. (P.G.W.)

## Applied mathematics

**APPLIED MATHEMATICS FOR ELECTRONICS, by L. J. Adams and R. Journigan. Published by Holt, Rinehart and Winston, Inc., New York, 1967. Hard covers, 6¼in x 9¼in, 702pp., many diagrams. Price in Australia $11.55.**

An up-to-date introductory text for the trainee technician, college student and serious home student, presenting in a concise and very readable manner the basic mathematical concepts involved in modern electronics. Unlike many existing books dealing with this material, it commences virtually "from scratch," introducing and developing the many new conceptions which have in recent years revolutionised the teaching and understanding of mathematics. As a result the initial chapters should make both interesting and worthwhile reading even for those with a good grounding in "pre-revolution" maths.

The applied nature of the material is emphasised throughout, with the result that the book is commendably free from "dry passages" of apparently abstruse mathematical introspection. Nevertheless the treatment is both thorough and rigorous, and considerable care is taken to clarify many of the more subtle mathematical points and methods so often glossed over in many books of this type.

The scope of the work should be made fairly evident by the chapter headings: 1 — Introduction; 2 — Addition and Subtraction of Whole Numbers; 3—Multiplication and Division of Whole Numbers; 4—Common Fractions; 5—Decimals; 6—Percent; 7—Introduction to Algebra; 8—Fundamental Operations; 9—Algebraic Fractions; 10—Equations to the First Degree; 11—Exponents and Scientific Notation; 12—The Metric System; 13—Ratio, Proportion and Variation; 14—Basic Concepts of Electric Circuits; 15—Systems of Linear Equations—1; 16—Systems of Linear Equations—2; 17—Radicals and Fractional Exponents; 18—Complex Numbers in Algebraic Form; 19—Quadratic Equations—1; 20—Quadratic Equations—2; 21—Introduction to Trigonometry—1; 22—Introduction to Trigonometry—2; 23—Sine Curves and Cosine Curves; 24—Vectors; 25—Logarithms; 26—The Slide Rule; 27—Alternating Current; 28—Analytic Geometry; 29—Introduction to Calculus; 30—Other Number Bases; 31—Boolean Algebra; 32—Matrices. As may be seen, the topics covered include virtually all those required for a solid grounding in electronics-orientated mathematics up to (approximately) technician level.

Each topic section in the book includes many illustrative worked examples, and concludes with a set of tuitional exercises. The book itself ends with some 13 data appendices, the answers to the odd-numbered tuitional exercises, and an index.

To summarise, a book which seems to this reviewer to be highly commendable in all respects. It should be of interest to anyone, whether he be a student, a practising technician, a "rusty" engineer, or a serious amateur, who seeks a maths text and reference which is fully up-to-date, thorough and at the same time highly readable.

Our copy came from the local publisher, Holt Rinehart and Winston (Aust.) Pty. Ltd., who advise that copies are available from all larger and technical bookstores. (J.R.)

## Electronic organs

**UNDERSTANDING ELECTRONIC ORGANS, Thomas Jaski. Published, 1968 by the Hayden Book Co., Inc. New York. Stiff paper covers, 207 pages 8¼ x 5½ inches. Illustrated with photographs, diagrams and circuits. Australian price $6.15.**

With electronic organs continuing to multiply in both number and variety, it is not surprising that books on the subject should do likewise. The latest to hand is this volume by Thomas Jaski.

Its approach is somewhat different from others that have preceded it and will, I think, find a different reaction from potential readers, depending on what they are looking for.

Chapter 1, "Sound and Music," reviews briefly the elements of the subject — the

hearing mechanism, pitch, level, beats, etc.

Chapter 2, involving about 31 pages, begins with an explanation of organ pipes and pipe tones and then launches into an explanation of how pipe organ waveforms can be analysed with the aid of graphs and tabulations, with a view to their simulation from electronic sources. Not having been through this exercise personally, this reviewer is not able to comment on how practical this material is. However, it is difficult to escape the conviction that organ designers, particularly those involved with complex waves and formants, will be less concerned with graphical exercises than experimenting till the result sounds right.

From here on, the book follows a fairly predictable pattern, explaining, in successive chapters, the basic design configurations of electronic organs, tone generators, formants and filters, tremolo, vibrato, chorus, celesta, sustain and percussion.

Other chapters cover amplifiers and power supplies, the mechanical design of typical key contacts, tabs and expression pedals.

The information contains a fair amount of "old" material ..(reed generators and valves) as well as new (effects and transistors). As such, the book will have only a limited value to the person who already has a collection of electronic organ literature. Its appeal will rather be to the person who is seeking a broad background on the subject covering the old as well as the new. Perhaps one should add that the person will need to have some comprehension of circuit diagrams, but this will be true of virtually any book on electronic organs.

Chapter 9, "Organ Accessories and Accessory Instruments" gives interesting information on rhythm devices (notably by Wurlitzer and Conn), the Hammond Solovox and the Novachord.

The book concludes with an appendix explaining pipe organ rank names, a bibliography, a glossary and an index.

Our copy came from Grenville Publishing Co. Pty. Ltd., 401 Pitt Street, Sydney, N.S.W. (W.N.W.)

## *Networks*

**RESISTIVE CIRCUITS, by Daniel S. Babb. Published by the International Textbook Company, Scranton, Pennsylvania, 1968. Hard covers, 6in x 9in, 313pp., numerous diagrams and circuits. Price in Australia $9.90.**

An introductory text on basic circuit theory, intended for the junior college student, the trainee technician and the serious hobbyist. It makes few assumptions regarding the mathematical background of the reader, presupposing mainly a basic knowledge of elementary algebra and trigonometry. From this it takes the reader carefully and thoroughly to a point where he has a good general grounding in the basic techniques involved in circuit analysis.

Whereas earlier circuit theory texts were intended to form part of a "DC-AC-transients" theoretical progression, the present book is designed to be the first text utilised in a somewhat more logical progression leading from "resistive circuits" to "single time-constant circuits" to "general networks." With this in mind the book deals quite generally with both DC and AC circuits, and also places special emphasis on concepts and techniques which the student will meet again and extend in dealing with analysis of more complex circuits.

A good idea of the scope covered is conveyed by the chapter headings: 1—Electrical Quantities and their Interrelationships; 2—Waveforms; 3—Terminology of Electric Circuits; 4 — Volt-Ampere Graphs and Resistance; 5—Fundamentals of Circuit Analysis; 6—The Series Circuit; 7—Parallel and Series-Parallel Circuits; 8—Networks and Network Equations; 9—Equivalent Circuits and Special Methods

of Circuit Analysis; 10—Dependent Sources; 11—Electrical Power. Each chapter includes many worked examples and tuitional problems, while the book itself ends with answers to the problems and an index.

Throughout the book the text seems to this reviewer to be clear and concise, with terms clearly defined and concepts well illustrated. The progression of material takes place in a logical and orderly fashion. In short, it would appear to be a very commendable introductory text on circuit theory, and one which would be well suited for any serious student.

Our copy came direct from the International Textbook Co., 400 Pacific Highway, Crow's Nest, N.S.W. 2068. They advise that supply can be arranged through local bookstores. (J.R.)

## Communications

**AN INTRODUCTION TO RANDOM SIGNALS AND COMMUNICATION THEORY, by B. P. Lathi. Published by International Textbook Company, Scranton, Pennsylvania, 1968. Hard covers. 6in x 9in. 48p.p., many diagrams. Price in Australia $15.40.**

A good for senior undergraduate students, graduates, engineers and physicists, presenting an introduction to and a development of the analysis of random signals and the contemporary theory of communication. A good grasp of calculus is assumed, although the approach adopted is essentially a physically-orientated and heuristic one rather than abstract and axiomatic.

The chapter headings read as follows: 1 — Signal Analysis; 2 — Elements of Probability Theory; 3 — Characterisation of Random Signals; 4 — Transmission and Filtering of Random Signals; 5 — Analog Date Communication: Modulation; 6 — Digital Data Communication: Signal Detection; 7 — Introduction to Information Theory. Each chapter ends with a list of selected references and tuitional problems.

The text would appear to be concise and well-expressed, and is plentifully illustrated by diagrams and examples. Accordingly it should be found both of interest and of value to those seeking a book on this subject at the level concerned.

Our copy came from the Australian office of the publisher. International Textbook Company, of 400 Pacific Highway, Crow's Nest, 2065, who advise that copies can be obtained through booksellers. (J.R.)

## Radio & TV handbook

**WORLD RADIO AND TELEVISION, HANDBOOK, 23rd edition, 1969. Published by the World Radio and Television Handbook Company Ltd., Hellerup, Denmark. Soft covers, 360 pages, size 9in x 6in.**

The 1969 edition of this now well-established text has been completely revised, as in past issues. However, this year not only has the material on stations, schedules and other related information been brought up to date, the 1969 issue is virtually a new book, larger than before (9in x 6in), and much thicker than previous issues (360 pages). It is crammed full of information of value to the radio listener, DXer and short-wave hobbyist.

The handbook is regarded by many who listen to radio broadcasts originating outside their own local area as an essential guide, as each edition lists every known radio and television station in the world. The material is arranged in two main sections, Radio and Television. Each section is first subdivided under continents and within these subdivisions stations are listed by countries, arranged alphabetically. Details are given of the relationship of local time to GMT, languages used, station postal addresses, personalities, schedules current at the publication date, frequencies, powers of transmitters and program highlights. In addition to the above, information is given on verification policy, future plans and any other material thought to be of interest.

A completely new 65-page section in the 1969 edition is a listing of medium-wave and short-wave stations by frequency. This covers Europe, Africa, Asia and the Pacific, North America, Central and South America and, in addition to frequency, shows power and location. The listing for U.S.A. contains details of more than 4,000 stations.

A noticeable feature of this new edition is that the section which has appeared at the front of the book in previous editions, containing contributed articles, is now very much shorter, as they have been transferred to the new publication, "How To Listen To The World," from the same company. However, such features as radio reception conditions for 1969, radio and television receivers in use throughout the world, complete listings of the world's television stations by country, solar activity in 1969, DX clubs of the world and many other interesting items have been retained.

The "World Radio and Television Handbook" has been used by this reviewer as a professional listener since its first edition in 1946, and this is by far the most comprehensive edition yet. Edited by J. M. Frost, the 1969 edition is indeed a reference manual unsurpassed in the field of broadcasting activity. The compiling of the mass of detail and ensuring that it is accurate, is a task of considerable magnitude and the invaluable information the handbook contains will be appreciated by all who use it. Next to your radio receiver and aerial, the handbook becomes your next essential in listening to the broadcasts from across the world.

A brochure on the handbook is available free on request from Arthur Cushen, 212 Earn Street, Invercargill, New Zealand, and copies of the book can be ordered from the same source, or are also available through technical booksellers in Australia. (A.C.)

## LITERATURE—in brief

**TECHNICAL NEWS BULLETIN,** Vol. 52, No. 10, October, 1968. Published by the U.S. National Bureau of Standards. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Contents: Precision Coaxial Current Comparator; Impact Spectrometer Found Valuable in Trace Analysis; N.B.S. Initiates Liquid Helium Study; Pumping Characteristics of Slush Hydrogen Studied; N.B.S. Improves Null-Point Potentiometry; Conference & Publication Briefs; Improved High-Frequency Voltage Divider; N.B.S. Measurement Seminars and Workshops, 1968-1969 Series; N.S.R.D.S. News; Standards and Calibration; Information Processing; Standard Reference Materials; Patents Granted on N.B.S. Inventions; Publications of National Bureau of Standards.

**MULLARD BULLETIN.** Published by Mullard Ltd., U.K. Inquiries to Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, N.S.W., 2000. Product information bulletin. Contents: Electronically

### Digital Electronics

"An Introduction to Digital Electronics" is a quarto-sized 104-page book published by "Electronics Australia." Written by Jamieson Rowe, B.A., B.Sc. (Tech.) it provides the engineer, technician or student with a clear and coherent introduction to basic concepts of the rapidly growing field of digital technology. Included are chapters describing the operation of ditital instruments and computers. Copies may be obtained by writing to "Electronics Australia," Box 2728, G.P.O., Sydney, 2001. Price, $2.20 post paid.

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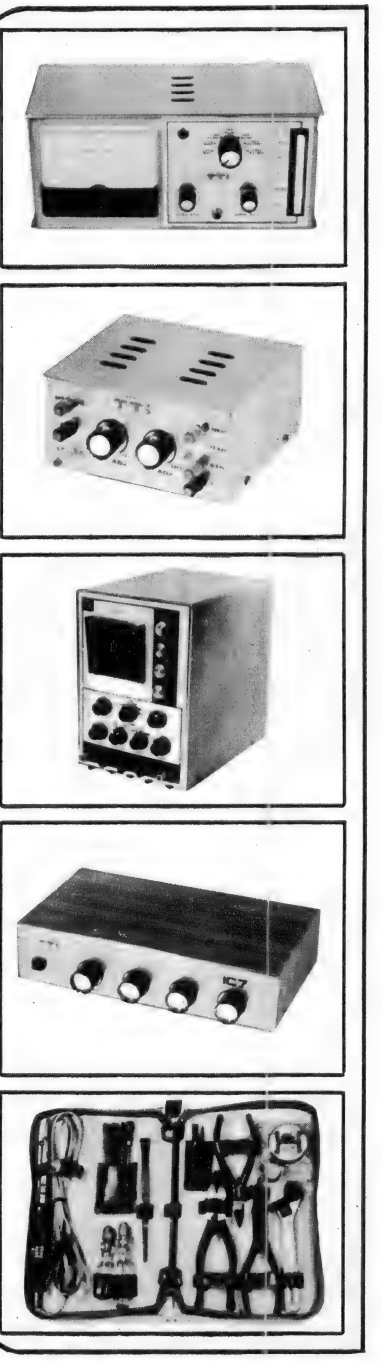

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tuned Gunn effect X-band oscillators; X to Q band varactor diode frequency multipliers; New Vinkor clip and board assembly; Encaspulated rectifier bridges; EHT modules; New MOS transistors; Channel electron multipliers; Vibrating membrane capacitor; Channel electron multipliers in panel arrays; New 11in monitor tube; Mullard "memory products;" Mullard magnet factory; Zener complexes with standard cell performance; Mullard in space communications; Mullard titanium sublimation pumps; Type CXY11 Gunn effect device; Low-cost "light beam" communication system; X-band varactor diode.

**MINIWATT DIGEST,** Vol. 7, No. 7, November/December, 1968. Published by the Miniwatt Electronics Division, Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. 2064. Contents: Transistor Equipped Aerial Amplifiers, Part I—designs for single- and multi-channel amplifiers giving low intermodulation at output powers from 10mW to 150mW; An SCR Firing Unit with Norbits; AC Static Contactor; Additions to Philips Technical Library — "Introduction to the Theory of Operational Research"; Transistors for Audio-frequency Amplification"; "Miniwatt Technical Data"; "Practical X-ray Spectrometry."

**HALLO FRIENDS,** No. 5, 1968. Published by Deutsche Welle, the Voice of Germany, Public Relations Department, Cologne, P.O.B. 344, Federal Republic of Germany. Contents: The Tenth Photokina in Cologne; Portrait — Erhard Eppler; A Pioneer of Self-Aid — Friedrich Wilhelm Raiffeisen; The Australia-New Zealand Association in Hamburg; 30 Years of Perlon — The Triumph of Synthetic Fibres; Rise and Fall of the UFA; A Special Kind of Collector; Decorated Steins Make Beer Drinking all the More Pleasurable; Spot Lights on Sports; Mailbag; Riddle; Technical Tips; Programs of Deutsche Welle; A Troll on Tegernsee — Olaf Gulbransson.

**MULLARD OUTLOOK,** Vol. 11, No. 5, September-October, 1968. Published by Mullard-Australia Pty. Ltd., 35-43 Clarence Street, Sydney, 2000. Contents: Viewpoint with Mullard; The TAA293 as a Schmitt Trigger and Multivibrator; Low Cost "Light-Beam" Infrared Communications System; "Whiskerless" Diode BAX-13 Uprated; Protection Circuit for a Stabilised Power Supply; New X-Band Varactor Diode; Audio Control Circuits Using Lockfit Transistors; Eight New Mullard Triacs; Microwave Shottky Barrier Mixer Diode; EHT Modules for Oscilloscopes; Image Intensifier Tube Operates from Starlight; Latest Mullard Devices for Hearing Aids; New Vinkor Clip and Board Assembly.

**VARIAN SPECTRUM,** Vol. 2, No. 2 (December, 1968). Published by Varian Australia Pty. Ltd., 38 Oxley Street, Crows Nest, N.S.W. 2065. Contents: Model 16K Kinetics Spectrophotometer Systems; High Intensity Illuminator System; High Energy, High Output Industrial X-ray in a Compact Package; New Techtron AA-5 Atomic Absorption Spectrophometer; Another NMR First from Varian, the HR-220.

**MINIWATT DIGEST,** Vol. 7, No. 6, September/October, 1968. Published by the Miniwatt Electronics Division, Philips Electrical Pty. Ltd., 20 Herbert Street, Artarmon, N.S.W. 2064. Special Norbit issue. Contents: Introducing the 60-Series Norbits — features and functions of the various units; New Components — The Norbit Simulator SIM 60; Practical Circuits with Norbits — circuits for general combinational logic functions, time delays, squaring of input signals, sequential circuits, and square wave generators.

**RADIOTRONICS,** Vol. 33, No. 4, November, 1968. Published by Amalgamated Wireless Valve Co. Pty. Ltd., Private Mail Bag, Ermington, N.S.W. 2115. Contents: A Precision Resistance Welding Control Using Integrated Circuits; News and New Releases; Triac Power Control Applications; Vacuum Capacitors; Transistor Dissipation in AF Amplifiers.

**NEW DEVELOPMENTS,** issue B040, December, 1968. Published by Jacoby, Mitchell & Co. Pty. Ltd., 469-475 Kent Street, Sydney 2000. New products magazine. Contents: PRD digital power meters; Telonic impedance comparator, Siliconix current limiter diodes; Kyoritsu vacuum tube voltmeter; Comark semiconductor testers; Weinschel coaxial slotted line; Sullivan ratio transformer, contact resistance bridge, precision decade capacitor, and precision fixed capacitor; Shinkoh null balancing recorder; TRW microwave transistors; Gossen precision meters; and CEC moisture monitor. The issue also includes a short article on the applications of the Sullivan ratio transformer.

**VARIAN ASSOCIATES MAGAZINE,** October, 1968. Published by Varian Associates, Palo Alto, California, U.S.A. Inquiries to Varian Pty. Ltd., 38 Oxley Street, Crows Nest, N.S.W. 2065. Contents: Varian Klystrons Power "Haystack" Tracking Feat; Lavern Kiedkmann Elected Instrument Group Vice President; Vice Presidents Elected as Varian Focusses on International Operations; Varian TWT Sets Precedent in Satellite Communications Systems; Four Varian Products Among Nation's 100 "Most Significant"; Management Profile — Arnold Wihtol.

**TELECOMMUNICATION JOURNAL,** Vol. 35, No. 12 (December, 1968). Published by the International Telecommunication Union, Place des Nations, 1211 Geneve 20, Switzerland. Separate editions in English, French and Spanish. Contents: Telecommunications and Health, by Patricia Palmer; Some Aspects of the Economics of Satellite Communications, by F. A. O'Nians and J. L. Blonstein; Universal Components of F2 Layer Critical Frequency, by Shri Chaman Lal. Under the heading of "Ideas and Achievements" are found descriptions of the Apollo-7 communications system; the scientific results obtained with the FR-1 satellite, and the East Africa earth station under construction near Nairobi.

**NEW TECHNOLOGY,** No. 22, November, 1968. Published by the British Ministry of Technology and the Central Office of Information. Available from the Central Office of Information, Hercules House, Westminster Bridge Road, London SE1, U.K. Contents: Computers Plus Communication; An ILO Helps Small Firms; Information "Fall-Out" for Industry from Patent Specifications; TV Programs for Industry Available as Films; Government Chemist Aids Fluoride Monitor Development; Design Data Memoranda for Chemical Engineers; News; Statistical Indicators.

**AMALGAMATED WIRELESS VALVE CO. PTY. LTD.,** can supply copies of the following publications (prices are post-free except where stated): Radiotronics, published quarterly, annual subscription, $2; Radiotron Designers Handbook, $7.50 plus 50c postage; Super Radiotron Valve Manual, $1.75; Phototubes and Photocells, 75c; Industrial Receiving-Type Tubes, 50c; RCA Transistor Manual, $2.50; RCA Linear Integrated Circuit Fundamentals, $3; EEV Abridged Valve Data Book 1968, free; Semiconductors and Transistors, 30c; RCA Photomultiplier Tubes, 60c; AWV Guide to Industrial Tube Products, free; RCA Integrated Circuits Product Guide, free; RCA Receiving Tube Manual, $2; RCA Transmitting Tubes, $1.50; AWV Picture Tube Interchangeability Chart, free; RCA Photo-Cells, 60c. Orders must quote the publication number where applicable, and should be addressed to the Sales Department, Amalgamated Wireless Valve Co. Pty. Ltd., Private Mail Bag, Ermington, N.S.W. 2115. ■

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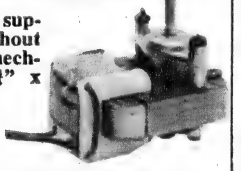

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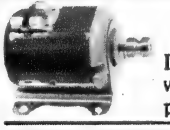

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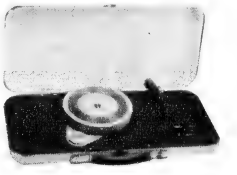

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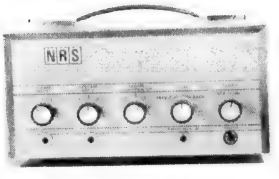


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# AMATEUR BAND NEWS AND NOTES

## *Amateur TV — Sydney Group's Activities*

A small enthusiastic group of radio amateur operators in Sydney is actively engaged in television experiments.

By Pierce Healy, VK2APQ*

For several years licensed amateur radio operators in Australia have been permitted to carry out experimental television transmissions. Many VHF/UHF enthusiasts have obtained television permits in conjunction with their amateur operator's licence. Except for a very small group in South Australia there has been little or no concentrated activity in other areas.

Recently several members of the VHF and TV Group of the New South Wales Division of the Wireless Institute of Australia began a concentrated effort to popularise this aspect of radio communication techniques and are already, following success with black and white transmissions, building equipment for experiments with colour television.

Grahame Wilson, VK2ZGW/T, a member of the VHF and TV Group, has submitted comments on the activities and other information on amateur television (ATV) in Sydney. These comments are given for the information of those who would like to join the group and to dispel some of the fears that prevent more operators becoming active in amateur television. Some details of the equipment being used by his fellow enthusiasts are also given.

Grahame expresses the view that the main reasons for the lack of activity are:—

Details of modern circuit data not being readily available.

The scarcity of photo tubes such as vidicons, for live cameras, or photo-multiplier tubes for flying spot scanners.

The fear of excessive cost and complexity in construction of equipment.

This small but very enthusiastic group in Sydney hopes to overcome some, if not all, of these problems. The group believes that amateur operators should diversify their interests in this technological age and amateur radio should become more involved in the enormous field of electronics.

"Television, while not including all aspects of electronics, covers a much more diverse field than radio; it has often been referred to as 'that epitome of electronics,' covering such fields as UHF, photoelectric phenomena, pulse techniques and frequency modulation. Television, today, is not as complex as many amateurs may think. The construction of a simple TV camera is not as difficult as a single side band transmitter and can be constructed for about fifty dollars."

At the present time there are two stations on the air, VK2ZAH/T at Hornsby Heights, operator Barry Gerdes, and VK2ZVV/T at Carlton, operator Vic Barker. Barry at the present time is using a QQE02/5 tube in the final of the transmitter on 432MHz with a power output of one to two watts. At a distance of about seven miles a picture can be locked on a mobile TV receiver, while the resolution of a test pattern at a distance of five miles is quite readable.

Barry also has another transmitter undergoing tests prior to being put on the air, using a pair of 4CX250Bs giving a power output of 80 watts on 432MHz.

Vic radiates a power of 30 watts and, despite his poor transmitting site, good pictures are received up to 10 miles away. Vic also has a colour television receiver and a 625 line sync pulse and colour bar generator. Both experimenters have two vidicon cameras each and over 400 lines can be resolved off air from each station.

At the present time active members of the ATV group are:—

| | |
|---|---|
| Barry Gerdes | VK2ZAH/T |
| Vic Barker | VK2ZVV/T |
| Grahame Wilson | VK2ZGW/T |
| Dennis Stokes | VK2ZPM/T |
| Ian Mackenzie | VK2ZIM |
| Richard Carden | —— |
| Leigh Harrison | —— |
| Peter Cearnes | VK2ZXB |
| Tom Lackenby | VK2ZTL |
| John Smith | VK2ARD |
| Kevin Barnes | VK2ZFI |

The question on availability of equipment is one most often asked. Unfortunately, very limited supplies are available from Australian sources and efforts are being made to obtain industrial vidicons. However, a range of components is available to members of the British Amateur Television Club (B.A.T.C.). Membership is open to all parts of the world, and the fee is 10/ stg.

The cost of some of the main items from B.A.T.C. are:

Vidicon Camera tubes (manufacturers rejects — slight blemishes) £10 stg.

Vidicon Yokes (scanning and focus coils for transistor circuits) £6/15/ stg.

Vidicon Bases 5/ stg.

"C" Mount lens flanges 8/6 stg.

All prices are plus postage.

Further details of the activities of the amateur television group in Sydney can be obtained by contacting:

Grahame Wilson VK2ZGW/T
29 Goodlands Avenue,
Thornleigh, 2120 N.S.W.
Sydney phone (after 6 p.m.) 84-5475.

The final comment from Grahame was: "How about building a simple 432MHz converter that can be used ahead of one of the vacant channels on your domestic television receiver. It gives amateur television experimenters a great deal of encouragement to know that their transmissions could be viewed by a number of people."

The regulations governing amateur television in Australia are given in the Postmaster-General's Department Handbook for Operators of Radio Stations in the Amateur Service. Revised September, 1967, it is obtainable from the Radio Branch, P.M.G. Dept. in all States.

Extracts from the section dealing with television experiments state:—

"Applications for permits to conduct television experiments shall be made in writing to the superintendent, Radio Branch, and shall indicate the nature of the proposed experiments and the type of system to be employed.

"The transmission or reception of television images may be undertaken only in amateur bands above 420MHz. The accompanying sound transmissions are permitted on any channel above 144MHz. The transmitter to be used shall employ a DC power input not exceeding 150 watts to the anode of the final transmitter stage.

"The following technical requirements must be adhered to in respect of equipment operating in the 420MHz-450MHz and 576MHz-585MHz bands, but in the higher bands any standard may be employed.

Number of lines:

(a) 175 lines per picture.

(b) 625 lines per picture, interlaced two to one.

Picture and field frequencies:

(a) Picture field frequency — 50 per second.

(b) picture frequency — 25 per second; field frequency — 50 per second.

Line frequency:

(a) 8,750 per second.

(b) 15,625 per second.

System of modulation:

Negative modulation (that is, a decrease in light intensity increases modulated power).

Method of scanning:

From left to right and from top to bottom.

Transmission amplitude characteristics:

The picture transmission must be confined within the limits of the amateur band in which the transmission is made. Double sideband transmission may be used where practicable."

### B.A.T.C.

Here are more details of the British Amateur Television Club. The club was founded in 1949 to inform, instruct and co-ordinate the activities of amateur radio enthusiasts experimenting with television transmission, and to liaise with other enthusiasts engaged on similar work overseas. The club is affiliated with the Radio Society of Great Britain, and has a membership of over 800. Of these about one third reside in Australia, Canada, France, the Netherlands and the United States of America.

The club publishes a quarterly magazine, "CQ-TV" which is issued free to members. This publication contains circuits, constructional articles, photographs and news of members' activities. Contributions to the magazine are welcome and members are asked to send in news of their activities, and in particular, to send in articles or any practical hints they may pick up in the course of their amateur TV experiments.

Headed note paper and lapel badges may also be purchased from the hon. secretary, and lecture tapes may be borrowed from the club.

The following books are recommended:

B.B.C. TV Engineering series (4 Vols.), Amos and Birkinshaw. Published by Iliffe.

TV Engineering by D. G. Fink. Published by McGraw-Hill.

TV Engineering Handbook. Edited by D. G. Fink. Published by McGraw-Hill.

Colour Television. P. S. Carnt and G. B. Townsend. Published by Iliffe.

Sound and TV Broadcasting—General Principles: K. R. Sturley. Published by Iliffe.

Some of the achievements by members of the B.A.T.C.:

*** News and notes of Divisional and Club activities submitted for inclusion in these columns should be forwarded direct to Pierce Healy, 69 Taylor St., Bankstown, N.S.W., 2200.**

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32-34 Graham Rd.,
Highett, Victoria. 3190.
Ph. 95-4086

May 1952 — The first two-way amateur TV contact in the world, G3BLV/T - G5Z/T.

August 1953 — G3GDR received G2WJ/T at 34-mile range with only two watts peak input.

December 1953 —Amateur colour pictures produced.

Spring 1956 — Colour pictures transmitted two-ways over a path of 12 miles.

Spring 1956 — Monochrome pictures exchanged over a 38-mile path.

November 22, 1959 —Slow-scan pictures from WA2BCW in New York received by G3AST in Yeovil.

Autumn 1963 — Two-way pictures exchanged over a path in excess of 200 miles, G3ILD - G3NOX/T.

Current experiments are directed towards better camera gear, slow scan television standards, the successful relaying of pictures, the use of micro-wave links and colour television.

The Club holds a Convention in London once every two years. During the Convention the general meeting is held, when officers of the Club are elected.

Membership costs 10/- stg. per annum, payable on January 1. New members are asked to enclose 1/- stg. per month remaining of the current year, 10/- stg. for the following year.

Application should be made to:
The Hon. Secretary, B.A.T.C.,
White Orchard,
64 Showell Lane,
Penn,
Wolverhampton, Staffs.

### NEW ZEALAND ATV

From the official journal of the New Zealand Association of Radio Transmitters, the following notes on ATV in that country were given:

Two groups of Canterbury amateurs appear to have set what may be a new Zealand record.

One group consisting of Ian ZL3TAA, Terry, ZL3TAU and Doug ZLTAR/3 braved a couple of hours in the fog and a gusting easterly wind on June 16 to establish a 432MHz amateur television link with Gavin ZL3LS in Ashburton, assisted by Max ZL3AAN.

Station ZL3TAU/3 was established near Cass Peak on the Port Hills above Christchurch for the purpose of receiving signals from Gavin ZL3LS, 45 miles away at Ashburton, thus creating a one-way New Zealand ATV record on 432MHz. The output from a vidicon camera was amplified to grid modulate a 3/20 final amplifier running either 24 or 30 watt input. The vision carrier was on 441MHz and was 625 lines per picture standard. The antenna was a small paraboloid.

The signal was picked up by ZL3TAU/3 on a seven over seven skeleton slot antenna, fed into a preamp, then to a UHF tuner, and then to a 11 inch battery/mains transistor portable TV set. The total battery consumption of the receiving equipment was 1.3A at 12 volts, the set having been modified to run an "S" meter and accept the input from the UHF tuner.

### SLOW SCAN TV

In the United States the Federal Communication Commission now permits the transmission of pictures, using narrow band modulation techniques, in the telephony sections of the amateur bands.

The portions of the 20, 15 and 10 metre bands in which transmissions may be made are:

14,200KHz to 14,235KHz
21,250KHz to 21,300KHz
28,500KHz to 29,700KHz

Either amplitude modulation, A5, or frequency modulation, F5, may be used for picture transmission. Very successful slow scan television transmissions have been made to amateur stations located in United States Antarctic bases.

Slow scan television transmission is also permitted in the 3.5MHz and 7.0MHz bands.

# BUSHFIRES—THE AMATEUR STORY

In last month's notes a brief resume was given of the activities of amateur radio operators and the Wireless Institute Civil Emergency Network during the disastrous bushfires in the Blue Mountains, last November. As those notes were compiled before all the details had been collated, some of the more important facets were not recorded.

Thanks to Ken Moore, VK2AVN, who commenced the 146MHz net when the emergency began, a report has been compiled giving an insight into the problems that have existed in the area during the past decade. Ken also acknowledges the assistance given by Bill Moore, VK2HZ, and B. Neurath, VK2ZJN, in preparing the following story.

After the disastrous bushfires in 1957, amateur radio operators in the Blue Mountains tackled the problem of the virtual non-existence of any bushfire communications systems. For several years the problem remained unsolved, although many enthusiastic attempts were made to launch such a system. By 1962 a small group of 144MHz portable/mobile stations emerged due, in the main, to the driving force of Wal Cromie, VK2MZ, whose abundant energy provided portable equipment for others to operate.

Three mobile stations, VK2MZ, VK2NK and VK2AVN were involved in the activities at that stage, with assistance from VK2ASZ, who at that time did not live in the mountains. Portable stations, VK2QA, VK2HZ, VK2RM and VK2ABK were manned at local fire stations whilst the mobiles accompanied the water tankers into the bush. Occasionally stations were operated from their home base in giving assistance. This network operated on 146.6MHz and for quite a time was effective, although limited.

Shortly after the net was formed and in operation, the Blue Mountains City Council obtained low band FM equipment for its water tankers and, to the disappointment of those concerned, that civic body discontinued its support of the amateur radio net. Their action did not, however, quite remove the enthusiasm of the operators.

From 1957 to 1968 the bushfire seasons on the Blue Mountains were mild and only minor outbreaks occurred. November, 1968, however, saw the culmination of a tremendous build-up of dry fuel, plus several weeks of hot dry winds. In fact, conditions indicated a blow-up was approaching.

A fire which originated in September, on the Kurrajong side of the Grose River, in fairly inaccessible country, was allowed to build up to huge proportions in the Grose Valley till it jumped the river and crept up behind Springwood. Finally local bushfire brigades burnt back on this fire at North Springwood in the White Cross area. Conditions were so "hot" in the area at the time that three men trapped on a section of the fire trail were caught between two hot updrafts and burnt to death. Still this fire was not completely extinguished and one smouldering pocket continued for weeks in Linden Gorge. This was the source of an outbreak which rose with freshening winds on Thursday, November 21st, and commenced to climb out of the gorge towards Faulconbridge.

By Saturday, November 23rd, this fire had crossed Grose Road and was threatening Faulconbridge and North Springwood. A strong south-westerly wind

was carrying the fire towards already burnt-out country in the White Cross area and it was thought safe at this stage. It was at this point that amateur radio operation commenced. Unfortunately, although the south-westerly wind caused the head of the fire to move very rapidly towards the burnt ground, the terrain which was encountered by its long tail allowed it to "whip" into unburnt country and be quickly fanned into fresh paths.

On Sunday, November 24th, one such manoeuvre carried the fire across Hawkesbury Road, North Springwood, and allowed it to run wild along the ridge to Yellow Rock and on to the Nepean River near Castlereagh. Several more "whips" brought the fire close to the townships of Warrimoo and Blaxland East. At this stage two homes in the North Springwood area had been destroyed but hundreds had been saved.

Monday, November 25th, saw a fairly quiet day with not much movement of the fire. Towards evening some hot pockets had crept in close to Springwood and began to flare, causing some concern. On Tuesday 26th these pockets became very dangerous and several outbreaks along the perimeter, now stretching from Faulconbridge to Mount Riverview, and Blaxland East refused to remain contained. By mid-afternoon properties at Mount Riverview were in grave danger and a very hot fire somehow passed them and into the region of the eastern escarpment, near Emu Plains.

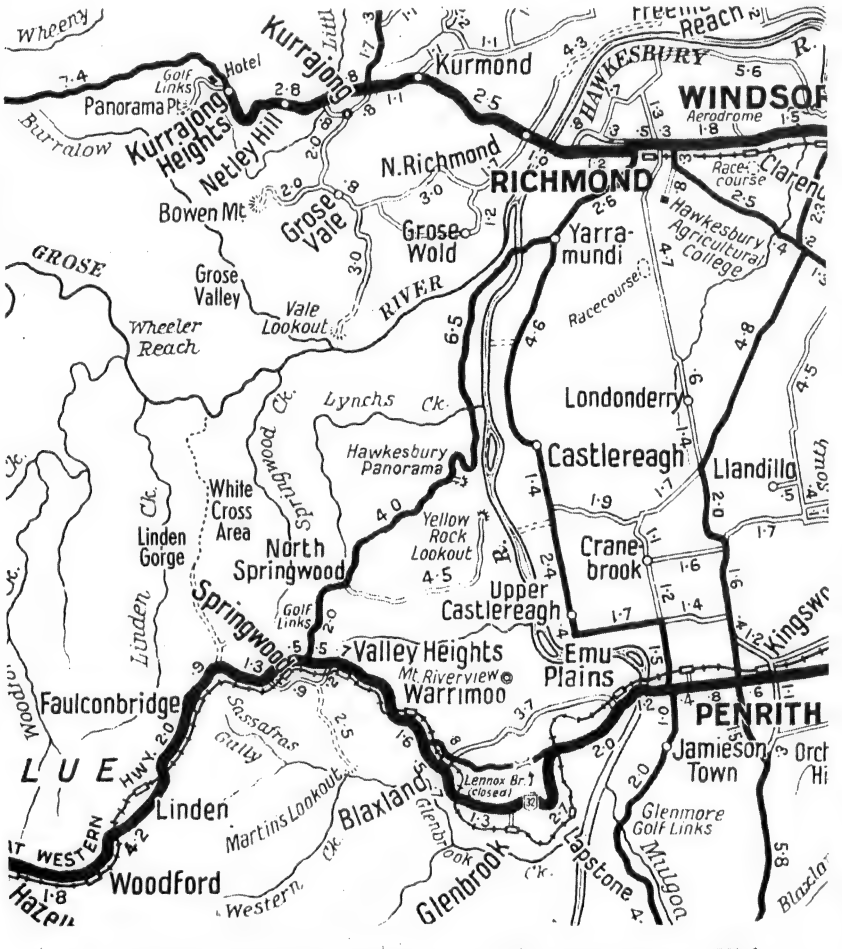
Wednesday November 27th was a ominously quiet day with freshening winds and temperature on the rise. Mopping up operations around the great semi-circle of the fire during the day left two remaining hot points by nightfall, one on the eastern escarpment and one near the top of Linden Gorge.

Thursday 28th dawned hot. Threatening gusts of wind fanned the Linden Creek end of the fire across the Western Highway and railway line above Faulconbridge. A new path was now open, through the south side of Springwood, Valley Heights, Warrimoo, Blaxland and Glenbrook through the new village of Lapstone to Emu Plains. The fire took only a matter of hours to cover this path pushed by strong swirling fire winds of up to 60 mile per hour. About 80 homes were destroyed and scores of properties damaged. About 50 square miles of country were burnt black as this fire swept clear off the mountains to Emu Plains, still destroying property in this area. Three more lives were lost that day.

The worst was now over, Friday 27th saw most of the active fire at the top of Linden. It burned steadily for two more days, sometimes endangering property, before it was finally contained. During the next week the grim trail was bathed in drizzling rain.

This then was the stage setting for perhaps some of the most acclaimed amateur radio co-operation seen in the area for some time.

As mentioned earlier, past efforts in this direction had not been greatly appreciated. However, real amateur zeal came to the fore. During the early stages of the fire, Danny Clift, VK2ZDE, proposed that a 146MHz FM network be established as a



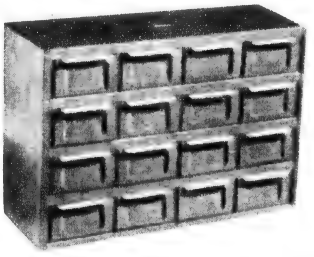

*Map of the Blue Mountains bushfire area. The Great Western Highway runs along the top of a ridge, with the terrain falling away to deep wooded gullies on either side. Penrith and Emu Plains are at the foot of the range, Lapstone on the edge of the escarpment. Top of the map is north. (Map by kind permission of Gregory's Guides and Maps Pty. Ltd., Sydney.)*

## CHEST OF DRAWERS

Three types of Galvanised Chests measuring 17⅛in x 6¾in x 11⅞in. containing 16 drawers, each measuring 6⅝ x 3¾in x 2⅛in.

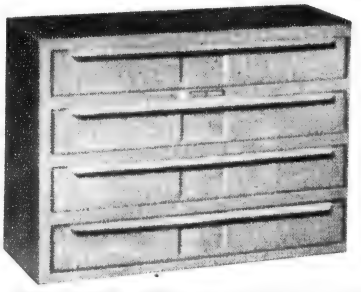
- TYPE C.D.1. With 16 undivided drawers, **$7.00.**
- TYPE C.D.2. With 16 triple compartment drawers, **$8.00.**
- TYPE C.D.3. With 8 triple compartment drawers, and 8 undivided drawers, **$8.00.**

The Chests are finished in blue hammertone stoving enamel, are complete with identification cards and packed in strong corrugated cartons. Provision is made for all units to be bolted together in tiers.



## CHEST OF DRAWERS TYPE C.D.4.

A 17⅛in x 6¾in x 11⅞in Galvanised Chest containing 4 full-length drawers each measuring 15¾in x 6⅝in x 2½in. Finished in blue hammertone stoving enamel. **$7.00.**



**WRITE FOR FREE CATALOGUE AND PRICE LIST OF TOOL BOXES AND CHEST OF DRAWERS.**

## MODEL M6 FOUR CHANNEL TRANSISTORISED MICROPHONE MIXER

All four inputs accept standard two circuit Phone Plugs, while the output jack accepts a standard circuit Phone Pin Plug.

**SPECIFICATIONS:**

● Input Impedance: "Hi" Impedance for Crystal Microphone, etc. ● Gain: Approximately 6 db. ● Maximum Input Signal: 1.5 volts. ● Maximum Output Signal: 2.5 volts. ● Output for Minimum Distortion: 2 volts. ●Hum: 0. ● Battery: 9 volts.

**Mono $6.75 Stereo $9.75**

## BELLPHONE

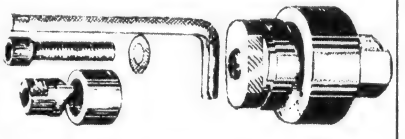
Pick up the receiver and dial push number desired.

**Price $9.00 per pair**

## KALTRO SVC TV-RADIO REMOTE CONTROl LISTENER

This TV-Radio Remote Control Listener is a combination of an extension speaker and a remote control station to regulate the sound of both the TV, Radio, Phono, or Hi-Fi set and the speaker incorporated in the Listener itself. In addition, up to two earphones can be attached for listening to the sound of the TV, Radio, Phono, or Hi-Fi set without disturbing others around you. Unwanted commercials can be easily cut off by merely turning down the control of the TV-Radio Remote control Listener. A modern designed plastic cabinet with easily adjustable fingertip controls ideal for use in home, office and business. Complete with earphone, 20ft of lead wire and installation instructions.

**Price $8.75**



## "PIPGRAS" HOLE PUNCHES

"PIPGRAS" Hole Punches are made from Alloy Tool Steel, and cut clean and accurate holes in sheet metal. They make a smooth, perfect hole without reaming or filing.

## SCREW TYPE, ROUND

Supplied with "UNBRAKO" High Tensile Socket Screws and Wrenches. Cut holes in sheet metal up to 18 gauge.

| Type No. | Nominal Size | Actual Size | Water Pipe Size | Pilot (I.D.) | Drill Size | Price Each |
|---|---|---|---|---|---|---|
| 32.S | ⅛in | 0.507in | — | ¼in | | $2.17 |
| 40.S | 5⁄32in | 0.618in | ¼in | 5/16in | | $2.17 |
| 48.S | ¾in | 0.742in | ⅜in | 5/16in | | $2.80 |
| 56.S | 7⁄32in | 0.884in | ½in | ⅜in | | $3.80 |
| 64.S | 1in | 1.008in | — | ⅜in | | $4.10 |
| 72.S | 1⅛in | 1.133in | ¾in | ⅜in | | $4.53 |
| 76.S | 1/3/16in | 1.172in | — | ⅜in | | $4.53 |
| 80S | 1¼in | 1.258in | — | ⅜in | | $4.97 |
| 88.S | 1⅜in | 1.382in | 1in | 7/16in | | $5.97 |

With Heat Treated, High Tensile Steel Hex. Head Bolt and Nut.

Cut holes in sheet metal up to 16 gauge.

| | | | | | |
|---|---|---|---|---|---|
| 96.S | 1½in | 1.512in | — | 9/16in | $6.68 |
| 112.S | 1¾in | 1.762in | 1¼in | 9/16in | $7.60 |
| 128.S | 2in | 2.014in | 1½in | 9/16in | $8.33 |

## THIS MONTH'S SPECIALS

| | |
|---|---|
| PK.633 Transistorised Tuners, 9 volt | $10.25 |
| PK.544 5 Transistor Miniature Push Pull Audio Amplifiers, 9 volt | $8.50 |
| Palace MD200 Audio Amplifier Module Imp. 5000 Ohm. Output, 8-16 Ohm. 9 volt. | $5.50 |
| Zephyr 26 x A Crystal Microphones | $0.75 |
| Resistance Boxes. | $4.25 |
| Capacitor Boxes. | $3.00 |
| D X Switches. | $3.00 |
| Megapet Loud Hailers Transistorised | $7.00 |
| Stylovue. | $1.50 |
| Micro Stylus Scope. | $3.00 |

## 8 WATT STEREO AMPLIFIER MODEL SA-80S OPERATING MANUAL

**SPECIFICATIONS**

Output Power: 8 Watt, 4 Watts per channel.
Frequency Response: 60 to 15,000 cps. plus or minus 1 db.
Harmonic Distortion: Less than 3%.
Hum and Noise: 52 db below rated output.
Sensitivity: Phone (Crystal) 100mV 250K ohm.
Tuner 100mV.
Tube Complements: 12AX7x1, 30A5x2, 1S315x1 (Silicon Rectifier).
Dimensions: 5.1lb. 9¾in x 6¼in x 3in.

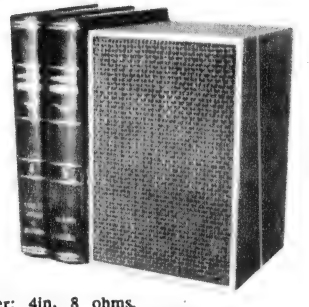
**Price $35.00**

## "PALACE" SOLID STATE STEREO AMPLIFIER Model AM-320

Power Output: 16W (8W per channel).
Frequency Response: 80-10,000 cps plus or minus 1dB 1W; 50-20,000 cps plus or minus 2dB 1W.
Harmonic Distortion: Less than 2% at 3W; less than 4% at 5W; less than 4.5% at 8W.
Tone Control: Bass plus or minus 10dB at 50 cps. Treble plus or minus 10dB at 10,000 cps.
Loudness Control: Plus 6dB at 50 cps; plus 4dB at 10,000 cps.
Input: Tape head 3.5mV; Mag. 3.5mV; Cer. 100mV; Tun., Aux. 150mV.
S/N Ratio: Minus 45dB.
Transistor complement: 2SB347 x 2, 2SB345 x 8, 2SB481 x 4.
Power Supply: 117V AC 50/60 cps.
Dimensions: 10¾in (W) x 3½in (H) x 8⅛in (D).
AM-V320 Upright.

**Price $92.00**

## BOOK SHELF TYPE SPEAKER SYSTEM MODEL SP-4S



Speaker: 4in, 8 ohms.
Frequency Response: 70-13,000 cps.
Sensitivity: 93dB.
Power Input: 8W (Music Power).
Cabinet Size: 9⅞in (H) x 6¼in (W) x 5⅞ (D).
Finish: Walnut lacquer.

**Price $12.50**

# *GENERAL ACCESSORIES*

(A DIVISION OF ELECTRONICS INDUSTRIES)

**116-118 CLARENCE STREET, SYDNEY 443 CONCORD ROAD, RHODES — 73-0211**

***BOTH STORES OPEN SATURDAY MORNING***

backup watch for the local fire brigades. Thus, on Saturday, November 23rd, VK2ASZ, VK2AVN and VK2ZDE moved into the fire area at North Springwood and, moving from point to point, provided communications back to local bushfire stations in the villages. To clarify this, it is pointed out that the normal system available to these brigades is from their mobile unit (water tanker or jeep) to a control centre, normally at Katoomba—this time at Springwood.

No contact is provided with the village fire centres, so that, except by telephoning the control centre, no township knows the whereabouts of its men. Arrangements for relief, feeding, etc., are difficult, and no knowledge of injuries can be made known to relatives. The first effort of this group was to fill that gap in communications.

On Sunday 24th VK2AQX joined VK2ZDE and VK2AVN and a similar arrangement was operated on Monday 25th. VK2ZFZ, and associate member of the Blue Mountains radio club, Gerry Vale, from Katoomba, joined the team, together with VK2MZ from Blaxland. Allan Smith, VK2ZFZ, provided a base station and with permission from the fire control officer of the local bushfire brigades, Bernard Dowling, the base was set up at Springwood alongside the bushfire network's own base. Stations operating that day included VK2AQX, VK2-ZDE, V2MZ, VK2ZFZ, VK2AVN and Gerry Vale assisting with base station operation.

Communication was still provided with the villages but a more important link was now established. A direct backup to the Springwood control centre had been provided. That evening at 8.00pm a quick conference was held, partly on the air, to plan the next day's operations. About the same time VK2ZMV called the 146MHz control station to advise that a bad outbreak had occurred behind his house, threatening it and other houses in Prince Street, Springwood. This was the first news of this outbreak and the fire control centre was quick to follow up. Numerous watertankers and men converged on the area including amateur radio operators with knapsacks, and the fire was brought under control.

On Tuesday 26th, base control was taken over by VK2HZ. VK2ZDE, having succumbed to a large intake of smoke, had the day off. VK2ZLX journeyed from Sydney for the afternoon and evening, joined the team consisting of VK2MZ, VK2AVN and VK2AQX. During Tuesday's operations calls had been received from Sydney WICEN stations and at the 8.00pm conference, these stations were thankfully invited to join the network on the mountains. Accordingly, on Wednesday 27th, VK2HZ manned the base station whilst other local operators had the day off—to go to work.

Mobile operation during the day was ably carried out by Sydney operators VK2VL, VK2GN, VK2AXJ, VK2ZZD, and VK2ZLX who, although strangers to the area, kept the control centre advised of activities in the area, particularly the eastern escarpment where the official channel failed through lack of an effective relay system.

Thursday 28th started as a normal day, with VK2HZ and VK2EX sharing operating duties at the base station, with VK2MZ, VK2ZZD, VK2ZSA and VK2ZDD in the field. However, it was quickly realised that this was the "blow-up" day coming. VK2ZDE, VK2ZFZ, VK2AVN, and VK2AQX left work and rejoined the net as quickly as possible as mobile units, while VK2WX joined the base station. At intervals during the week operators would leave their sets to help in the fire fighting operations. On Thursday this became more imperative and VK2HZ, VK2MZ, VK2AVN and VK2ZDE all stopped transmission for a period to fight successfully for their own homes.

Later VK2ASZ joined the expanding group and provided a 240V motor generator when the power mains supply failed at the Springwood control centre. He also provided a trickle charger which helped to keep the Bushfire Control station on the air. When the telephone services failed, lines being destroyed by fire, VK2HZ and VK2ZDE set up a 53 MHz link between the control centre and the Springwood N.S.W. Fire Brigade station; a very valuable service, as this was the only link at the time between the two fire fighting networks.

At this point a call from Civil Defence State Headquarters brought their Penrith section into operation. The Nepean District Amateur Radio Club members set up a 53MHz base at Penrith, using VK2BAU's equipment, and established a link with VK2DU at Warrimoo, VK2WI the Wireless Communications Centre in Sydney and the Springwood stations. VK2AWW set up a 146MHz base at Penrith and VK2ADF, VK2ZNS, VK2ZNJ, VK2BGP and VK2BRL joined the network assisted by George Drew (Associate). Civil Defence used their 3732KHz network in which VK2AMY and VK2AVA gave assistance.

Late on Thursday afternoon, Bob Pinning, VK2CT, who had been fighting fires in the Warrimoo area, collapsed and died. Bob had not been active in the amateur network operation but died "with his boots on" in a very gallant fashion. His passing caused a noticeable hush in net operations.

Also on Thursday, VK2ZXC, VK2FK and VK2VX arrived on the scene from Sydney and worked in the net operations. VK2ZXC was heard on many occasions passing traffic via his complex mobile installation.

Operations on Thursday continued well into the night and took many forms. Telephone trunk lines, intermittent all the week, were now completely open circuit and many messages were passed to friends and relatives via Sydney amateurs, VK2HL, VK2ZMQ and others. Civil Defence traffic was handled, lost children reports received and investigated, and a host of other messages handled. In fact the versatility of the amateur operators far outshone the rest.

Friday 29th was operations as usual, with dangerous fires still burning. VK2HZ and VK2EX maintained the base at Springwood. The Penrith group kept watch on fires in the Regentville-Mulgoa area. VK2ZDD, VK2ZZD and VK2DU maintained a composite 146MHz and 53MHz relay point at Warrimoo. VK2-ZDR, VK2ZQX and VK2AQX operated mobile in both areas while VK2BAU on 53MHz, VK2ZDE and VK2AVN on 146-MHz operated in the Linden area. Operations tapered off during Friday as the fires gradually eased. Networks were closed at Springwood on Friday night, and at Penrith on Saturday morning. However, all members remained on call for several days.

The general result of the services provided by the amateur radio operators was a wonderful "shot in the arm" to the relations with firefighting organisations in the State. The Bushfire Committee Radio Officer, Howard Freeman, VK2BHF, Inspector Bill Hodder, Blue Mountains District Inspector of the New South Wales Fire Brigade, Blue Mountains Fire Control Officer, Bernie Dowling and many others associated with the control centre at Springwood were all very generous in their praise of the efforts of the amateur radio operators.

A lot of traffic passed through the amateur net, such as fire reports, personnel movements, reports, etc., were mere duplicates of those on the official network. However, in many instances the amateur net arrived with a "scoop" and the bushfire controllers soon learnt the value of the amateur operators. Some of the instances where the amateur net "hit the front" have been mentioned but some may never really be known.

As well as handling messages, amateur operators also performed many "quick fixes" on bushfire radio equipment. This is another valuable aspect of amateur service in emergencies; by reason of the practical experience they have acquired over the years, they have the ability to cope with most technical emergencies, often exhibiting considerable ingenuity when the exact replacement component required is not available.

Most of those taking part also did some evacuating of persons in danger areas on Thursday. Roland, VK2AQX proved very valuable in this sphere with his VW bus. The report concluded with comments from Bill Moore, VK2HZ.

"It is practically impossible to get a full picture of all activity and assistance rendered by the many amateur radio operators, some of whom journeyed from Sydney to assist. Everyone was so busy in net operations, that an individual story of each amateur's work could never be recorded. I should like to thank all those involved for their excellent co-operation and assistance."

And from Ken Moore, VK2AVN:-

"I should just like to add my personal thanks and to say that due largely to my own involvement in this operation, I may have omitted a callsign. If I have please accept my apologies and understand that we have undergone a severe crisis here on the mountains . . .your help was wonderful."

# W.I.A. ACTIVITIES

Information was received from Geoff Wilson, VK3AMK, W.I.A. Awards Manager, that amendments have been made to the W.I.A. List of Countries for DXCC Awards, published in the December issue of these notes. It is understood that a current list was to be published in the January issue of the Institute magazine, "Amateur Radio."

However, at the time of writing, details were not available and therefore neither amendments nor comments on the changes can be made in this issue. It is hoped to include a summary in a future issue so that readers may being their list up to date.

Members are reminded that items for inclusion in the agenda for the 1969 Federal Convention of the Federal Council of the Institute should be forwarded to their divisional secretary without delay.

### A Gentleman's Agreement

Interference between stations using various modes of transmission is one of the problems that occur on the amateur bands. Several approaches have been made to reduce the incidence in several countries with varying degrees of success. The approach most frequently used and respected is termed "The Gentleman's Agreement."

Circumstances recently made it necessary for this aspect to be drawn to the attention of some operators. The case for accepting the gentleman's agreement was given by the president of the New South Wales Division during the Sunday news broadcast from VK2WI.

"Over the past month or so a number of heated exchanges have been heard on various high frequency bands between phone and C.W. operating stations.

"This is the old story of phone users operating in the low end of the high frequency bands, and which crops up from time to time.

"Many years ago, when the increasing congestion to the amateur bands began to pose a problem, some overseas licencing authorities, particularly the Federal Communication Commission in the United States of America, divided the bands into segments for the exclusive use by phone or C.W. modes. These regulations were made law and the F.C.C. continued to thoroughly police them over the years.

"The same situation eventually rose in Australia and other countries. But the Australian licensing authorities were reluctant to take regularity action and Australian amateur operators came up with the scheme for band sharing, which resulted in the old-fashioned scheme of a gentleman's agreement.

"Like a lot of old-fashioned ideas, this agreement was founded on commonsense and has now been the Wireless Institute of Australia policy for many years.

"It has served the amateur operator well and is used in some form throughout the world. It will continue to assist the amateur operator if a little consideration and thought for the other fellow is applied to operating practices. In many cases breaches of this agreement are due to the lack of knowledge of the rule which cannot be found in any handbook. However, some cases of, 'blow you Jack I am all right' have been heard.

"To these gentlemen I would say — please co-operate and you will find that you will gain much more pleasure from your operating time as well as not finding yourself as some sort of outcast from the rest of the amateur fraternity.

"For the benefit of new licensees and others who have forgotten the precise terms of the agreement, it reads as follows:—

3500KHz to 3535KHz C.W. only.
3535KHz to 3700KHz Phone and C.W.
7000KHz to 7030KHz C.W. only.
7030KHz to 7150KHz Phone and C.W.
14000KHz to 14100KHz C.W. only.
14100KHz to 14350KHz Phone and C.W.
21000KHz to 21150KHz C.W. only.
21150KHz to 21450KHz Phone and C.W.
28000KHz to 28200KHz C.W. only.
28200KHz to 29700KHz Phone and C.W.

"The frequencies just quoted are those agreed to in Australia and vary slightly to those in other countries, but are much more generous than the regulations enforced in the United States of America."

Agreement on the frequencies quoted was reached at the 1964 Federal Convention of the Wireless Institute of Australia held in Adelaide. The C.W. portion of the 21000KHz band was in accordance with an undertaking given as a member of the International Amateur Radio Union. Other frequencies were the result of examination of band occupancy and comments from Australian amateur operators.

# W.I.A. YOUTH RADIO SCHEME

### New South Wales

On Friday evening, December 20, the first Youth Radio Club Scheme broadcast was made from the Communication centre at the Wireless Institute Centre, 14 Atchison Street, Crows Nest, to members of the N.S.W. section.

The broadcast was made on 3560KHz in the 80metre band at 7 p.m. using the call sign VK2AWI. From reports received from various country stations reception was good and the service appreciated by members.

### Maitland Radio Club

From Colin Hay, Technical Publicity officer for the Maitland Radio Club, comes some interesting facts on their activities.

1968, the first year of operation for the Club, has been a year of hard work and anticipation, liberally sprinkled with surprises. Much has been achieved through the resourcefulness of the members, from a one room meeting at the Maitland Technical College to their own self-contained clubrooms complete with lecture room, communication centre and workshop.

The total membership of the club now exceeds 70 and it is interesting to note that the total attendance at club meetings and social gatherings during the year was 1,467 persons. Recently, Alderman N. Unicombe, Mr C. G. Cooke and Mr W. Plant VK2AMM were elected to act as Trustees for the club.

Members have constructed a radio tower and erected the front fence as well as preparing flower gardens and planting shrubs, while the storemen have catalogued the large amount of equipment and components that have been donated to the club during the past 12 months.

Apart from activities at the club, members have been busy constructing projects and equipment. Ray Johnson and Allen Counsel, the first two members to gain their licence through participating in the club classes, are busy constructing 144MHz equipment.

1969 promises to be as progressive as 1968, with three important functions occurring in February.

The first and most important is the official opening ceremony of the premises of the Maitland Radio Club by the Minister for Defence, the Honourable Allen Fairhall M.P. (VK2KB).

The annual general meeting will also be held in February and will officially mark the end of the first 12 months of the club's operations. The election of officers for the ensuing year will take place at the meeting.

As February is the beginning of the financial year of the clubs activities, applications for membership are being accepted as well as membership fees and subscriptions for the Club magazine — M.R.C. News—for 1969.

The third important function is the Maitland Show. It is anticipated that club members will organise a display of equipment and films relevant to club activities. The feasibility of setting up an amateur station using the club call signs VK2ZVM and VK2BHV is also being considered. Members will be in attendance to discuss and advise visitors on the objectives and merits of the Maitland Radio Club and amateur radio in general.

All enquiries regarding club membership, fees and club activities should be directed to the Secretary, Maitland Radio Club, Box 54 P.O., East Maitland. 2323, or by telephoning Maitland 33-7286 (STD area code 049)

Magazine subscriptions should be directed to the Editor, M.R.C. News, at the above address.

### South Australia

With schools in recess over the Christmas period very little news has come to hand. However, examinations were held at the Port Pirie and Elizabeth clubs on December 14. Successful students were:

Elizabeth Amateur Radio Club
Junior Certificate: Clifford Merry, Credit.
Paul Philbrook, Pass.
Port Pirie Youth Radio Club:
Elementary Certificate:
Darryl Donaldson, Pass.
Junior Certificate: Michael Ada, Credit.

### Western Australia

The superintendent of the Western Australian section of the Youth Radio Scheme Rev. Bro. Jack Morgan, VK6RT has been transferred to Victoria and has therefore been forced to retire from the position he has so capably filled. Bob Trapp, VK6BT, is going to act as Y.R.S. Superintendent until elections are held in April.

The council of the Western Australian Division have expressed their thanks to Jack for the work he has put into the Y.R.S. in that State.

### NEW SOUTH WALES

After considering many factors, the council of the New South Wales Division have decided to transfer the Annual Field Day-Convention, usually held over the Australia Day weekend, to a date to be decided later in the year. The main reason for this decision was to get away from the unpleasantness of the hot weather that is prevalent during the January-February period of the year. A tentative date being considered is toward the end of March.

### WESTERN AUSTRALIA

News that the call sign VK6TS has been issued to the Carnarvon Amateur Radio Club has just come to hand. This club, located at the centre of the large communication complex for satellite and space craft tracking, will be popular among the amateurs employed at the site.

The club is expected to become very active as the equipment being constructed is completed and put on the air.

### Jamboree-on-the-Air

The report by the national organiser, Noel Lynch, on the activities in Australia during the 1968 Boy Scout Jamboree-on-the-Air, contained some very interesting facts and figures on the event. Individual reports from branch organisers throughout Australia and Papua-New Guinea recorded many interesting overseas contacts and the excellent co-operation that amateur radio operators gave in setting up stations at Scout camps or inviting Scouts to their home stations.

Figures compiled from the participation reports received by the national organiser from all sources show an increase over the 1967 summary.

| | |
|---|---|
| Participation: | |
| Scout Groups | 503 |
| Girl Guide Companies | 133 |
| Number of Amateur Stations | 415 |
| Contacts between stations: | |
| Within Australia | 4173 |
| With overseas | 836 |
| Total contacts | 5009 |

Total number of Scouts, Guides and visitors who participated were 8,504.

Acknowledgements were included in the report for the assistance given the Scouting movement by the Wireless Institute of Australia and Australian amateur radio operators in general and the publicity given to the event in various publications.

The reason and importance of this world-wide event is summed up in the final paragraph of Noel's report.

"The spirit of the Jamboree-on-the-Air must continue to grow and certainly it must be a moving and powerful force toward the ideals of all organisations who work toward world peace. It should therefore continue to expect the support it deserves for the attainment of this worthy ideal."

# MULLARD MAGNAVOX

**BOOKSHELF ENCLOSURE**
**Maple, Teak or Walnut**
**Complete $24.75**
**SUPER BOOKSHELF $36.75.**
**Post: N.S.W. 50c. Interstate $1.00.**
**CABINETS ONLY**
**R. H. BOOKSHELVES $11.50**
**MULLARD $10.95**

**BOOKSHELF UNITS**

| 6in | 8in | 10in | 12in |
|---|---|---|---|
| $27.75 | $33.50 | $35.50 | $36.50 |

## GUITAR AMPLIFIERS

10-Watt, Two-Channel, with Twin Cone Speaker .. .. .. .. **$53.55**
14-Watt, 4 Inputs, Bass and Treble Boost, 2 Twin-Cone Speakers, **$63**
17-Watt, Four-Channel, Bass and Treble Boost. Two Twin-cone Speakers .. .. .. .. .. .. **$76.25**

### 35 WATT

4-Channel, Bass and Treble Boost. 4 Twin-Cone Speakers .. **$109.05**
Vibrato with foot control and 2 preset controls for frequency and intensity. **$10.50** extra on above models.

### 14 plus 14 WATT

With Reverberation. May be used as 28 Watt or as 14 Watt plus 14 Watt Reverb. Two 9 x 6 Woofer Speakers. Two 9 x 6 Twin-Cone Speakers. 4 Channels. Bass and Treble Boost. Foot Vibrato control included.

**$163.50**

**SLAP BASS OR BASS GUITAR 40-WATT AMPLIFIER**
4 Input Channels. Bass and Treble Boost. Two 12in Radial Beam Speakers. Perfect reproduction on 20 cycles.

**$159.75**

### PIGGY BACK GUITAR AMPLIFIER

30 Watt .. .. .. .. .. .. **$79.75**
45 Watt .. .. .. .. .. .. **$99.75**
60 Watt .. .. .. .. .. .. **$119.75**
4 Inputs. Bass and Treble Boost. Vibrato if required, **$10.50** extra.

### ELECTRIC GUITAR

**Pickup Units .. .. .. .. $8.75**
**Accordion Pickup Units .. $8.75**
**Harmonica Pickup Units .. $1.95**
**Post, N.S.W. 40c; Interstate, 75c.**

### FUZZ BOX

**FUZZ BOX E. AND A. AUG. WIRED AND TESTED. $15.**
**Post., 75c.**

### REVERB UNIT

**COMPLETE with AMPLIFIER. E.A. October issue. Kitset $39.95. Wired and tested, $41.95.**

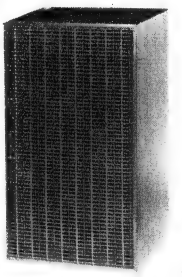
### 15-INCH HI-POWER SPEAKER

30 and 50-WATT RMS. Specially designed for Guitar, Organ, Bass, etc.

**$30.00**

### INTER. COM. UNITS

2 Station Transistorised
**$11.95**
4 Station, including Master
**$20.95**



## "MYERS" AUTOMOBILE STEREO TAPE PLAYER

**12 VDC. 1 amp operation. Size 3, 4 and 8 track cartridges can be played. Automatic starting and selecting. 12 silicon transistors. Freq. response. 70-10,000 cps. Tape speed 3¾" per sec.**

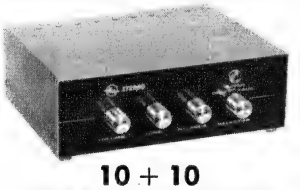
**$99.50**

**240 VAC model available, includes P.U. or radio input. .. .. .. .. .. $99.50**

### PLAYMASTER 106 AND 107

Feb. and March Elect. Aust.

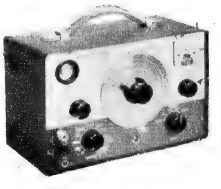
**106**
WIRED AND TESTED **$94.75**
**107**
WIRED AND TESTED **$83.75**



### 10 + 10 STEREO AMPLIFIER

E.A. November.

Kit Set .. .. .. .. .. .. **$59.75**
Wired and tested .. .. .. **$69.75**



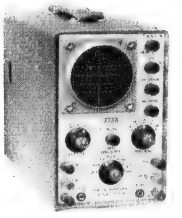
### T. E. 46 RESISTANCE-CAPACITANCE

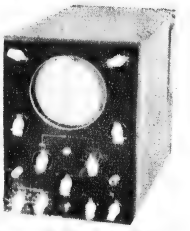
**Bridge and Analyser. Capacity 20 pf to 2,000 mfd. Resistance 2 ohm to 200 megs. Also tests power factor, leakage, impedance, transformer ratio, insulation resistance to 200 megs. at 600V.**

**Indications by eye and meter.**

**$49.75**

# TEST EQUIPMENT





## WIDE BAND OSCILLOSCOPE

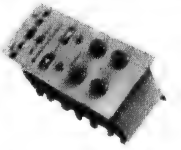
**5 Meg. Bandwidth Push-pull vertical and horizontal Amplifiers, 8 positions, high sensitivity vertical Amplifier, Frequency Compensated on all positions. Calibrated .02 to 600 volt. Hard time base, 20 cycles to 75K. Latest American R.C.A. circuitry. Complete with probe.**

**3-inch $102.75; 5-inch $118.75**

**T.O.2 TV AID $64.50**

### PLAYMASTER 115

**The new solid state Stereo-Amplifier. April issue.**
**Wired and tested .. .. .. .. $104.00**
**Kit Set .. .. .. .. .. .. $90.00**
**Pre-amp to suit magnetic cartridge .. .. .. .. .. 12.00**



### 119 STEREO TAPE ADAPTER

**Suits all Playmaster Stereo amplifiers and others that accept crystal P.U.**

**Kitset .. .. .. .. .. .. .. $79.00**
**Wired and tested .. .. .. .. $96.00**

### TAPE PLAYBACK KITSET

**BSR deck with parts for transistor pre-amp and circuit.**

**$30.00**

**Post $1.25 N.S.W., $2.00 Interstate.**

**Easy to build. Hi-Fi quality.**

### TAPE DECKS B.S.R.

**2 Track, 3¾ i.p.s.**
**$25.50**
**4 Track, 3 Speed Stereo.**
**$41.50**

### 240v A.C. POWERED SOLID STATE STEREO

**T.S.135**
18 Transistor. 15-watt per channel. Inputs for Tape. Mag. P.U. Ger. P.U. Radio Aux. Frequ. Range 30c to 20KC. Max Sensitivity 3 MV. Speaker matching 4 to 15 ohms.

**$78.00**

### A.2C. STEREO AMPLIFIER

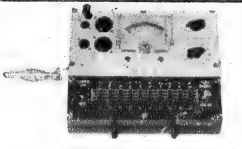
**5 WATTS PER CHANNEL.**
Valve Unit. 240v A.C. Input for Crystal and Ceramic P.U. Radio and Auxiliary. Output for 4, 8, 15 ohms. Cross talk better than -40db. Sensitivity 50 MV.

**$47.50**

### UA 41A - 20-20

**SOLID STATE STEREO**
20 watts per channel. Inputs for tape, magnetic and ceramic P.U. Tuner and aux. Teak cabinet.

**$88.00**



### VALVE TESTER

**Tests all valves, diodes, rectifiers, checking filaments, shorts, Merit on direct reading. Good-bad meter. Complete with tube chart.**

**$27.75**

**Post., N.S.W., 25c; P'state, $1.25.**

### T.E. 50-99-5011

**Checks, Nu Vistas, Compactrons, etc.**

**$34.95**

**Post: N.S.W. 25c; P'state $1.25.**

### G.D.O. UNITS

**Post., N.S.W., 50c; P'state, 75c. T.E. 15 Transistorised, 7 Band, 360 Kc to 270 Megs.**

**$35.75**

### SOLID STATE VTVM

E.A., Dec.
Wired. Tested.
**$49.50**

### AUDIO GENERATOR

**De Luxe Model TE—22D. Freq. range. Sine 20 cps—200 KC. SQ. 20 cps—25KC. Output voltage, Sine 7V. SQ. TV P.-P. Output impedance 1000 ohms. Acc. 5 per cent. Distortion less than 2 per cent. 4-range attenuation. 1/1, 1/10, 1/100, 1/1K. Printed circuit. 240V A.C.**

**$42.95**

### SIGNAL INJECTOR

**Transistorised. Fountain pen-sized Unit for Signal Tracer in Radio, TV and Amplifier Service. $5.75. Post. 25c.**

### TRANSISTOR AND DIODE TESTER

E.A. August, '68.
Wired and Tested.
**$57.00**
**KIT SET $48.00**

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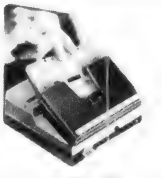
## SCHAUB-LORENZ "TOUROCORD" TAPE CASSETTE PLAYER



★ 12 volt D.C. operation.
★ Connect with 7-pin plug provided into your car radio.
★ Use the same speakers.
★ Plays with full frequency anywhere, any time.
★ Play the music you like, free of static, fading and commercials.
★ It can be plugged into your stereo home record playing equipment to the tape playback sockets. The reproduction will be as good as your equipment.
★ Can be used with portable radio or A.C. Radio when connected to ½ amp power supply.

**UNIT 1:** Fully imported from Germany portable stereo player complete with speakers in cabinets. PE Mode 2001 **Retail Price $240.00.**
**Our Price, including Schaub-Lorenz cassette player . . . . . $200**
(Retail price of cassette $70.00, refer technical review May, 1968, edition of "Electronics Australia.")
This is an excellent unit value for money.

**UNIT 2:** Monarch stereo amplifier, 2 Wharfedale 8" RSDD super loudspeakers, P.E. 34 belt driven hydraulic controlled lowering device turntable, Empire 808 cartridge, frequency response from 10—20,000 cycles.
**TOTAL PRICE . . . . . $220**
The same with Kenwood TK25OU amplifier. (Add $40.00 to the above price.)
The same with Sansui AU-222 amplifier. (Add $35.00 to the above price.)

**UNIT 3:** 2 Leak Sandwich loudspeakers, Armstrong 421 stereo transistorised amplifier, 15-watt per channel RMS, frequency response from 20—20,000 cycles plus/minus 1 dB less than ½% distortion on the full 15-watt RMS, Dual 1019 Hi-Fi turntable, Empire 888E cartridge, frequency response 10—30,000 cycles.
**TOTAL PRICE . . . . . $580**
The same with Armstrong 426 tuner/amplifier (Add $60.00 when purchasing the complete unit.)

**UNIT 4:** Ampex 753 tape deck combines magnificent 4-track stereo sound, unmatched Ampex engineering quality and versatile new recording features, sound on sound, tape monitor, sound with sound, echo chamber, complete with Armstrong 226 tuner/amplifier 10-watt RMS per channel frequency response from 30—20,000 cycles plus or minus 1dB less than ½% distortion measured at 8-watt RMS, 2 Goodmans Twinaxiette loudspeakers, 8" frequency response from 40—18,000 cycles, P.E. 34 turntable and Empire 808 cartridge frequency response from 10—20,000 cycles.
**TOTAL PRICE . . . . . $700**
The same with the Armstrong 426 fully transistorised tuner/amplifier. (Add $50.00.)

**UNIT 6:** ERA Mk 3 turntable, the arm tracks at 1/10th of a gram, the springs are damped by polyurethane foam so that the resonant frequency of the suspended mass is 2 cycles. Empire 888TE cartridge frequency response from 6 to 32,000 cycles. Harman Kardon Model 210 tuner/amplifier, power output: 50 watts IHF, frequency response: plus/minus 1 dB: 8 to 25,000 Hz at 1 watt normal listening level); 10 to 23,000 Hz at full rated power, harmonic distortion: less than 1%. 2 Empire 2000 loudspeakers, frequency response from 30—18,000 Hz, components: 10-inch high-compliance woofer with 2" voice coil 8 Mid-range/tweeter direct radiator, maximum power handling capacity: 60 watts undistorted, impedance: 8 ohms.
**TOTAL PRICE . . . . . $1,370**

**UNIT 9:** Sansui AU-222 amplifier, Dual 1010 turntable.
**TOTAL PRICE . . . . . $190**
The same with 2 Jordan Watts loudspeakers complete in cabinets, frequency range on axis: 30—17,000 Hz plus or minus 3 dB, 25—20,000 Hz plus or minus 6 dB also on axis, 30 degrees off axis: 30—17,000 Hz plus/minus 6 dB $160.

**UNIT 5:** Schaub-Lorenz Model 4000 tuner/amplifier made in Germany, 25-watt per channel, is the most beautiful looking tuner/amplifier available on the world market. The sound reproduction is excellent, broadcast, short wave, long wave, ultra short wave, FM, magnetic input, provision for tape recording and tape playback. Dual 1009 turntable, Empire 888 cartridge frequency response from 10—24,000 cycles, 2 Jordan Watts loudspeakers frequency response on axis 30—17,000 Hz plus/minus 25—20,000 Hz plus/minus 6 dB also on axis, and 30—17,000 Hz plus/minus 6 dB 30 degrees off axis.
**TOTAL PRICE . . . . . $460**
The same with ERA Mk 3 turntable. (Add $80.00.)

**UNIT 7:** Empire Model 9000M loudspeakers (2), frequency response: 20 to 20,000 Hz, components: 15-inch high-compliance woofer & Mid-range direct radiator and ultrasonic domed tweeter, both coupled to Empire's wide-angle acoustic lens, crossovers: 450 and 5000 Hz, maximum power handling capacity: 100 watts undistorted, impedance: 8 ohms. Schaub-Lorenz Model 4000 tuner/amplifier, made in Germany, 25-watt per channel, ERA Mk 3 turntable, Empire 999VE cartridge frequency response from 6 to 35,000 cycles.
**TOTAL PRICE . . . . . $2,200**

**UNIT 10:** Armstrong 127 tuner/amplifier AM/FM tape recording and playback facilities. 2 Wharfedale 8" RSDD loudspeakers, Dual 1010F turntable.
**TOTAL PRICE . . . . . $240**
The same with Heco 2-speaker system, separate base and treble, complete in cabinets, fully imported from Germany. Add $50.00.

## RECORDED MUSIC SALON

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# LISTENING AROUND THE WORLD

**Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.**

## *Maldive Islands Widely Heard*

Many of our readers have reported reception of the Maldive Island Broadcasting Service and its subsequent verification has added a new country to many log books.

The verification card from the Maldive Island Broadcasting Service at Male is sent registered airmail and is issued by the Department of Information and Broadcasting. In our case the reply coupon was also returned. The card shows a map of the island group and, on the reverse side, gives verification details as well as frequency, power and opening times of transmissions. The best reception has been on 4740KHz during the English period, 1515-1730GMT.

| GMT | KHz | KW |
|---|---|---|
| 0100 | 7150 | 2.7 |
| 1100 | 6150 | 2.7 |
| 0300 | 6150 | 2.7 |
| 1300 | 3331 | 15 |
| 0500 | 1507 | 7.5 |
| 1515 | 4740 | 30 |
| 0700 | 9538 | 15 |
| 0900 | 7150 | 2.7 |

### TESTS FROM DARWIN

Radio Australia's new booster station at Darwin officially commenced its initial test on December 20, though previous to this date reception of some frequencies had been observed. The first of three 250KW transmitters is now on the air as follows:

| GMT | KHz |
|---|---|
| 2330-1000 | 15270 |
| 1500-1730 | 15270 |
| 1000-1130 | 9595 |
| 1130-1500 | 9650 |
| 2100-2200 | 7160 |

### AFRICAN SIGNALS RECEIVED

Signals from Africa and the Middle East area are being well received by Robert Shepard, of Glen Iris, Victoria. The following is a recent survey of these signals:

ETHIOPIA: Radio ETLF, Addis Ababa, with the gospel program "The Voice of the Gospel," was heard using 15170KHz, and opened at 0430GMT with identification anouncements in English, French and Swahili. French programs were heard at 0445GMT and the station left the air at 0530GMT. Another channel, 9695KHz, was heard at 1700GMT with a news bulletin in English and at 1715GMT a news bulletin in Swahili was carried. ETLF is also using 6065KHz with English identification, and at 1620GMT a program in Arabic follows.

NIGERIA: Radio Nigeria, Lagos, is using a new frequency of 1536KHz, and sign on was noted at 0600GMT. News in English was heard at 0600 to 0610GMT, and the same program is carried on 21455KHz. Lagos has also been head on 7275KHz at 1700GMT when a news bulletin in English was broadcast with the program beamed to West Africa.

GHANA: Radio Ghana, Accra, was heard on 21545KHz in Portuguese at 1710GMT with a service beamed to Mozambique. Another 13M frequency, 21720KHz, has a service in Swahili, heard 1545 to 1645GMT. Another channel, 6130KHz, was noted at 1700GMT with English announcements and African music for reception in West Africa.

EGYPT: Radio Cairo, with its "Voice of the Arabs" service, is using the new frequency of 15300KHz and has been heard at 0500 to 0600GMT.

SOMALI: Radio Mogadiscio uses 9590KHz and the station has been logged at 1730GMT with a new bulletin in English. A program in Arabic followed at 1745GMT.

### BROADCASTS FROM LEBANON

The present schedule from Radio Lebanon at Beirut is as follows, according to Mr S. L. Morgan, of Bendigo East, Victoria:

| | |
|---|---|
| **African Service** | |
| **GMT** | **KHz** |
| 1830-2030 | 15350 |
| **South America Service** | |
| 2300-0100 | 15340 |
| **North America and European Service** | |
| 0130-0400 | 11785 |
| **Omnidirectional Service** | |
| 0430-0730 | 5980 |
| 1625-1820 | 5980 |
| 0925-1600 | 9545 |
| English is Broadcast | |
| 1830-1900 | 15350 |
| 0230-0300 | 11785 |

### RADIO KUWAIT ON 17750KHz

The Kuwait Broadcasting Service has been heard in its English program from 0400-0600GMT on 17750KHz. The music program is mainly of English and American "pops." News in English is broadcast at 0530 and the station leaves the air at 0600GMT following the National Anthem. According to the sign off announcement the next English program is broadcast at 1600GMT and news is at 1615GMT. The station is still testing, and as well as this channel they are also using 9520, 4967, 6055, 11940, 15150 and 21525KHz. The power of the transmitter is 250KW.

### SMALL ISLAND — BIG POWER

Bonaire, one of the smallest islands in the Netherlands Antilles, will soon be one of the most powerful sites for international broadcasting. Transmitters located on the island will have a total output of 1400KW.

Bonaire, known as the Flamingo Island, because the salt flats at the southern end of the island are the nesting place for thousands of these birds, is about 25 miles long and five miles wide. The transmitters of Trans World Radio have been established for some years at a point on the south of the islands, with the studios near the centre of Bonaire. The transmitters are one of 500KW on medium wave, and one of 250KW on short-wave. Radio Nederlands is building its relay station nearby, and this will use two 300KW transmitters. In the meantime, the programs of Radio Nederlands are relayed by Trans World Radio.

The group of islands in the Netherlands Antilles are often known as the ABC islands (standing for Aruba, Bonaire and Curacao). Bonaire is located about 65 miles off the coast of Venezuela and is linked by shipping and air service to Curacao, the main point of entry into the group. The use of the island as a relay base for rebroadcasting of programs for the Americas, Africa and the Pacific area in the past few years has increased the interest in Bonaire, which, with its population of only 6,000, is now regarded more as a radio relay island than as a virtually unknown Dutch colony, as it was in the past.

### EDDY'S BOOKSHOP

One of the regular features of the Happy Station program of Radio Nederland Hilversum, Holland is Eddy Startz's "Bookshop," in the Sunday program in which he offers free to listeners several printed items.

The Happy Station calendar and program schedule is always available, as is a special verification card in reply to a reception report. This shows the jovial compere of the program and has details of the recent fortieth anniversary of the Happy Station.

An aerial folder is available to help improve short-wave listening; also a con-

## ENGLISH FROM ROME

Broadcasts from Rome Radio, in the Italian Broadcasting System's short wave service, are transmitted to the following schedule:

| GMT | KHz | Area |
|---|---|---|
| 0100-0120 | 11810, 9595 | North America |
| 1935-1955 | 11810, 9710, 7275 | Great Britain |
| 0425-0440 | 7275, 5990 | Mediterranean |
| 2025-2045 | 11905, 11800, 9575 | Near East |
| 2200-2225 | 15310, 11805, 9710 | Japan |
| 0350-0410 | 21560, 17795, 15310 | South Asia |

verter booklet which gives details on the conversion of a receiver to cover the 13, 16 and 19 metre bands; and booklets on Hilversum, Amsterdam and Rotterdam.

The reception of the Happy Station on Sunday is as follows:

| | |
|---|---|
| 0600-0720GMT | 6020, 9715KHz |
| 0730-0850 | 9525, 11940KHz |

The address is P.O. Box 222, Hilversum, Holland.

### B.B.C. WORLD RADIO CLUB

The B.B.C. World Radio Club, has now been in operation for more than one year, and is well received in the Pacific area every Sunday at 0930GMT. The best frequencies are 15070, 17790, and 21550KHz. This weekly program is of interest to broadcast DX enthusiasts as well as those concerned with amateur radio. The program consists of talks on radio subjects, and each week four minutes of DX News is included in the program. Membership in the Club is free and readers should write to B.B.C. World Radio Club, Bush House, London, W.C.2, England for further information.

### BROADCASTS FROM THE F.E.B.C.

The Far East Broadcasting Company, in Manila, Philippines, operates in many languages in its gospel programs. The present schedule of frequencies and times of transmission includes a program to Australia and New Zealand, 0900-1000 GMT daily, on 11890, 17810 and 21515KHz.

| GMT | KHz |
|---|---|
| 2030-1615 | 6030 |
| 2140-2300 | 6120 |
| 2130-2330, 1245-1730 | 7230 |
| 2215-2345, 1045-1330 | 9505 |
| 2130-2315, 1330-1730 | 9715 |
| 2245-2330, 1030-1245, 1615-1730 | 11855 |
| 0815-1030 | 11890 |
| 2115-2330, 1000-1230, 1400-1615 | 11920 |
| 2345-0030, 0300-0700, 0815-1615 | 1530 |
| 2330-0700, 0815-1030, 1245-1630, 1745-1815 | 15440 |
| 2145-2345, 2400-0600, 0815-0930 | 17810 |
| 0100-0700, 0815-1000 | 21515 |

### ENGLISH FROM HAVANA

The present schedule of Radio Havana, Cuba, includes broadcasts in English to Europe, Africa and North and South America.

| GMT | KHz |
|---|---|
| 2010-2140 | 17705 |
| 2050-2150 | 17750, 15285 |
| 0100-0450 | 9525 |
| 0100-0600 | 15285 |
| 0330-0600 | 11760 |
| 0630-0800 | 11930 |

### RADIO OMDURMAN SCHEDULE

According to a verification letter, Sudan Broadcasting Service is operating as follows:

| GMT | KHz |
|---|---|
| 0400-2200 | 9508, 7200, 4994, 1295, 764 |
| 1300-1340 | 9508, 7200, 4994, 1295, 764 to South Sudan. |
| 1340-1400 | 9508, 7200, 4994, 1295, 764 to Europe. |

All programs are in Arabic except the transmission to Europe.

### S.A.B.C. FREQUENCIES

The frequencies used by the South African Broadcasting Corporation for the relay of its domestic programs on shortwave is listed in the World Bulletin by Richard Ginbey, Vanderbijlpark, South Africa, as follows:

| KHz | KW |
|---|---|
| English | |
| 3285, 3965, 7270, 9680 | 20 |
| 6095, 9720 | 100 |
| Afrikaans | |
| 3320, 3952, 7230, 9650 | 20 |
| 6005, 11735 | 100 |
| Springbok Radio | |
| 3250, 3997, 7195, 9720 | 20 |

An all-night service is carried on 3250 and 3997KHz.

# NEW SCHEDULES OPERATING

### TRANSWORLD RADIO

The present schedule of Trans World Radio, Bonaire, Netherlands Antilles, is as follows:

| GMT | KHz | Language |
|---|---|---|
| 0800-0900 | 6110 | Portuguese |
| 0900-0930 | 6110 | Spanish |
| 0930-1100 | 9730 | Spanish |
| 1100-1235 | 11820 | English |
| 1100-1230 | 11820 | English (Sunday) |
| 1230-1500 | 15140 | English (Sunday) |
| 1955-2010 | 15435 | Eastern Europe |
| 2010-2025 | 15435 | French |
| 2030-2100 | 15435 | German |
| 2100-2130 | 15435 | English |
| 2130-2145 | 15435 | Spanish |
| 2145-2200 | 15435 | Portuguese |
| 2200-2215 | 15435 | French |
| 2220-2300 | 15350 | Spanish |
| 2300-2330 | 15350 | Portuguese |
| 2330-2355 | 15350 | German |
| 2330-0020 | 9695 | Spanish |
| 2355-0010 | 15350 | Portuguese, Spanish, German |
| 0010-0025 | 15350 | Spanish |
| 0030-0100 | 15350 | German |
| 0100-0130 | 15350 | Russian |
| 0130-0220 | 15350 | Spanish |
| 0225-0350 | 9695 | English |
| 0400-0430 | 11820 | Russian |
| 0430-0445 | 11820 | Arabic, Armenian |
| 0445-0500 | 11820 | Eastern Europe |

### BROADCASTS FROM VIENNA

The Austrian Broadcasting Service, Vienna, has transmissions on shortwave for various parts of the world as follows:

| GMT | KHz | Phase | Area |
|---|---|---|---|
| 0400-2305 | 6000 | A/B | Europe |
| 1800-2000 | 11925 | A | Europe (North) |
| 1000-1200 | 9770 | B | Europe (East) |
| 0500-0700 | 7245 | A | Europe (South East) |
| 1300-1500 | 11785 | A | Europe/North Africa |
| 0700-0900 | 7245 | A | Europe (West) |
| 0500-1300 | 6155 | A | Europe/North Africa/Middle East |
| 0900-1300 | 7245 | A | Europe/North Africa/Middle East |
| 1300-1700 | 9770 | A | Europe/North Africa/Middle East |
| 1500-1700 | 11785 | A | Europe North Africa Middle East |
| 1700-2200 | 6155 | A | Europe/North Africa/Middle East |
| 2000-2200 | 7245 | A | Europe/North Africa/Middle East |
| 2300-2400 | 6155 | B | North America |
| 0000-0400 | 6155 | A | North America |
| 2300-2400 | 9770 | A | North America |
| 0000-0400 | 9770 | B | North America |
| 0000-0200 | 15380 | B | Central America |
| 2300-2400 | 9525 | B | South America |
| 0000-0200 | 9525 | A | South America |
| 0200-0400 | 11870 | B | South America |
| 1800-2100 | 15210 | B | South America |
| 0700-1000 | 17855 | B | South Africa |
| 1600-1800 | 17880 | B | South Africa |
| 0600-1800 | 15410 | B | Middle East |
| 1700-2000 | 9610 | B | Middle East |
| 0400-0700 | 17715 | B | S.E. Asia |
| 1400-1600 | 17775 | B | S.E. Asia |
| 1000-1200 | 17885 | B | Australasia |
| 1200-1400 | 15325 | B | E. Asia |

Phase A means that transmissions are on even dates.
Phase B means that transmissions are on odd dates.

### BROADCASTS FROM LISBON

The present transmission schedule of Emisora Nacional, Lisbon, Portugal, is as follows:

| GMT | KHz | Language |
|---|---|---|
| 0100-0145 | 15315, 11840, 9585 | Spanish |
| 0200-0245 | 9680, 11935, 6025 | English |
| 0345-0430 | 9680, 11935, 6025 | English |
| 0315-0300 | 11935 | French |
| 0300-0345 | 11935 | English |
| 0745-0830 | 7130, 6185, 6025 | French |
| 1830-1915 | 7130, 6025 | French |
| 1915-2000 | 7130, 6025 | Italian |
| 2000-2045 | 7130, 6025 | German |
| 2045-2130 | 7130, 6025 | English |
| 0730-0900 | 21495, 17880 | English |
| 1430-1515 | 21495, 17895 | English |
| 1730-1815 | 17895 | French |
| 1815-1945 | 17895 | English |
| 1730-1815 | 21495 | French |
| 1815-1915 | 21495 | English |

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# FLASHES FROM EVERYWHERE

## EUROPE

**PORTUGAL:** The Radio Portugal DX session called Radio Safari, produced by Richard Ginbey, of South Africa, is now on the air every second Monday of the month. The session can be heard 0815-0900GMT on 21495KHz in the transmission to the Pacific.

**DENMARK:** Radio Denmark, Copenhagen, recently celebrated its 20th anniversary of international broadcasting and issued a new verification card to mark the occasion. The present schedule includes broadcasts to South America in Spanish at 2145-2215GMT daily, except Sunday; and Danish 2100-2145 GMT, using 15165KHz.

## AFRICA

**MALAGASY:** Radio Malagasy, Tananarive, now has a new home service transmitting from 1530 to 1900GMT on 4955KHz. The same program is on MW on 1187KHz. A program in French and English on the international service has been observed on 17730KHz from 1330 to 1430GMT. A report from Richard Ginbey, of South Africa, confirms these details in a recent issue of the "World Bulletin."

**TOGO:** Radio Togo, at Lome, is now operating Monday to Friday 0530-0900, 1200-1400, 1630-2300GMT; Saturday 0530-0900, 1200-2300GMT; Sunday 0530-2300GMT. These transmissions are on 1394KHz (1KW) on medium wave; and on 6155KHz (4KW), 5047KHz (100KW) and 7265KHz (100KW) short wave.

**ECUATORIAL GUINEA:** This country, until recently Spanish Guinea, has now changed to this new name. Emisora de Radio Diffusion Santa Isobel, Fernando Poo, is now broadcasting in English at 1900 to 1945GMT. The station uses the frequency of 6250KHz, but the opening time of the English service is irregular. The signals have been noted at 1911GMT with a musical request program, according to reports from South Africa. A report from Canada lists the sign-off of the local program service as 2300GMT.

**GHANA:** Radio Ghana, at Accra, has revised its transmissions. That in Arabic 2000-2045GMT and in English 2045-2215GMT has appeared on 15285KHz, a move from 9545KHz. A further signal on 9760KHz at 2000 to 2100GMT has been observed, while news in English at 1800GMT is received on 4915KHz. DXers interested in joining Radio Ghana's monitoring club are invited to write to Senior Broadcasting Engineer, P.O. Box 1630, Accra, Ghana.

**TUNISIA:** Radio Tunis is using the new frequencies of 21475KHz with news in French at 1710-1720GMT. Sweden Calling DXers reports that an Arabic broadcast can be received on 5980KHz with news at 2100GMT and sign off at 2300GMT.

**SOMALI:** Radio Somali, Mogadiscio, has been heard with frequent commercial announcements in the English program 1730-1800GMT on 6095KHz. It appears these programs are directed to Kenya and Tanzania as the prices quoted are in their currency.

**MOZAMBIQUE:** Radio Pax, at Beira, on 7205KHz, has been heard in Japan with an interval signal consisting of a xylophone signal before 1800GMT, followed by a program in Portuguese. Signals in Japan have been reported to be at fair level. Two new 10KW transmitters of the Radio Club at Mozambique, are to commence testing in June. The station is located at Beira, and the frequencies to be used for the test of this new regional station are, as yet, unknown.

**EGYPT:** Cairo is received on three frequencies in the 13M band and English news has been noted at 2100GMT on 21750KHz. Another frequency, 21605KHz, has been noted in Indonesian at 1315-1330GMT. The frequency of 21585KHz is being received at 1700-1715GMT with English programs for the India-Pakistan area. Radio Cairo with "Voice of the Arabs" transmission is on the air 24 hours a day. Transmissions are as follows:

| GMT | KHz |
|---|---|
| 0300 | 15300, 7215 |
| 0600 | 11980, 7215 |
| 0800 | 17840, 15345 |
| 1100 | 17905, 17840, 15345 |
| 1400 | 17905, 15345 |
| 2100 | 15300, 9525 |
| 2200-0300 | 17905, 15300, 9525 |

English to North America is:

| | |
|---|---|
| 0200-0330 | 9475 |

**NEW TIMES FOR DX SPECIAL**

The broadcasts of Trans-World Radio DX Special program, from Monte Carlo and Bonaire, a weekly feature of news for the shortwave listener, have been retimed.

| GMT | KHz | Day |
|---|---|---|
| **Monte Carlo** | | |
| 0730 | 7295 | Thursday |
| **Bonaire** | | |
| 1105 | 11820 | Friday |
| 2100 | 15340 | Friday |
| 0335 | 9695 | Sunday |

## ASIA

**TAIWAN:** The Voice of Free China at Taipeh has etxended its service area and at 0200GMT now has an English program which is beamed to Japan, Hawaii, United States, Hong Kong, Macau, Australia and New Zealand. Best reception is on 15345KHz.

**KUWAIT:** The Kuwait Broadcasting Service, P.O. Box 397, Kuwait, will resume tests again using a 250KW transmitter, according to a report from the station. Plans are to test on 6055, 11940, 15150, 17750, and 21525KHz. The station will welcome reports. The new 250KW transmitter is already used on its regular schedule on 17750KHz from 0430-0600GMT with English programs, and also at 1600 to 1730GMT on 11940KHz. The English program is carried on 4967 and 9520KHz, and on medium wave 1133 and 1345KHz.

**MONGOLIA:** According to a verification recently received, Radio Ulan Bator in Mongolia now transmits daily in English as follows:

| GMT | KHz |
|---|---|
| 1220-1250 | 7345, 9540 |
| 2200-2230 | 11810, 11850 |

**INDIA:** All India Radio has announced its winter schedule to Europe:

| GMT | KHz |
|---|---|
| 1745-2230 | 7215 |
| 1745-2030 | 11620 |
| 1945-2230 | 9912 |

**PAKISTAN:** Some changes have been noted from Radio Pakistan, Karachi. English news is observed from 0210-0220 on 15335KHz. A new frequency of 15382KHz is reported in the World Bulletin as being received at 0230 and 0300GMT. Another new frequency 15455KHz is the regional station at Dacca and has been heard at 0100GMT.

**VIETNAM:** The Saigon station VTVN is being received with Vietnamese programs at 1100GMT on 6165KHz according to the World Bulletin. The same program is carried on 7175 and 9620KHz, while a further program in Vietnamese has been received on 7245KHz at 1100GMT. VTVN at Dalat on 6115KHz and Hue on 9670KHz also are being received at 1200GMT with the local Vietnamese service.

**TURKEY:** Radio Ankara is now using a new 250KW short wave transmitter for its foreign service. The present reception is best on 15160KHz, opening in Turkish at 0430GMT. The power on this frequency is 100KW.

## THE AMERICAS

**BRAZIL:** Radio Nacional de Brasilia has verified reception reports from the address of C.P1620, Brasilia. The attractive verification card shows new buildings in Brasilia, and the schedule is given as 0900-1330, 2035-2130 and 0000-0100GMT. The station uses 6065, 9665, 11720 and 15445KHz.

**URUGUAY:** Radio Official SODRE is again being received on 15275KHz, and is on the air from 1130 to 0230GMT. The station has been off the air for some months, and the frequency in use has been as low as 15273KHz.

**GREENLAND:** Godthab confirms reception with a folding card. According to a recent letter from Mr B. Knogh, of Gronlands Radio, the schedule in Danish and Greenlandish is 2030-0230GMT daily. The station uses 570-KHz with 25KW, 650KHz with 5KW, 820KHz with 5KW, on medium wave; and 3990KHz, 5960KHz and 5980KHz all with 1KW. Reception of this station has been possible in New Zealand at 1030GMT, but the morning broadcast period seems to have been cancelled.

**COSTA RICA:** La Voz del Victor, at San Jose, has verified a reception report and gives the information that the power on medium wave 625KHz is 1000KW. On short-wave 9615KHz, the power has been increased to 50KW. Another San Jose station, Radio Reloj, has been heard on 6065KHz in New Zealand at 0700GMT; this is a frequency change from 6205KHz. This station made such a move last March, but returned to 6205KHz after some weeks on the new 6065KHz channel.

**NOTES FROM READERS should be sent to ARTHUR CUSHEN, 212 Earn St., Invercargill, N.Z. All times are GMT. Add 8 hours for Perth, 10 hours for Sydney and 12 hours for Wellington. All frequencies in KHz.**

## BROADCAST BAND NEWS

**NEW ZEALAND:** During November, the New Zealand House of Representatives passed the Broadcasting Authority Bill which will allow the establishment of a Broadcasting Authority to issue licences to private commercial radio and television stations in New Zealand. These stations will be in competition with present N.Z.B.C. stations, and already companies are being formed to operate in the radio field. Radio Hauraki has been outlawed by a new Post and Telegraph regulation which prohibits the operation of a radio station outside territorial waters, and is thus similar to the British Marine Offences Bill. The Government has delayed the operation of the new regulation until Radio Hauraki's application for a land-based station has been heard by the Broadcasting Authority. It is known that Radio Hauraki has made application for the 1480KHz frequency.

The major concern will be to find frequencies for the new stations. There are 233 stations in operation in Australia and New Zealand, sharing 107 channels. Of these, Australia has 33 clear channel stations and New Zealand 1, which means that 199 stations are using 83 frequencies between them. It looks as if the A.B.C. and Australian Commercial Radio will have to allow the sharing of some of these clear frequencies with stations either in Australia or New Zealand, in order to accommodate the proposed private radio stations for New Zealand.

However, the New Zealand Government is confident that the problems will be overcome. The Minister of Broadcasting advised the House recently that there were 29 frequencies available for new stations, and with consultation with Australia this could be increased to 47. It was envisaged that the number of private stations would be small. He also pointed out that the N.Z.B.C. would be protected against loss of revenue arising from newcomers to the commercial field.

**WAKE ISLAND:** A new radio station is reported to be operating on Wake Island in the Central Pacific. The station, using the call sign KEAD, is on 1490KHz, with programs in English 24 hours a day.

# ANSWERS TO CORRESPONDENTS

*When writing to us:—*

- *Please give your name and full postal address, including the State and Postcode.*
- *Write the above information clearly or, for preference, print it in block letters. Your co-operation will facilitate delivery of replies by mail, where such are called for.*

**BINDERS, INDEX:** Do you supply binders and annual indexes for Electronics Australia? I am loath to part with my copies once I read them, but a stack of 12 tends to be rather unwieldy! **(G.D.D., Wembley Downs, W.A.)**

● An index is published in each volume of Electronics Australia, usually in March of each year. Binders may be obtained for $2 each plus 25c postage from Photo-Sales, John Fairfax and Sons Ltd., Box 5026, G.P.O., Sydney, 2001.

**READER BUILT IT:** I would like to know if the circuit on page 89 of your October issue will operate from 12V DC. If so, could you let me know what changes are necessary. **(G. H., Toongabbie, N.S.W.).**

● This was a "Reader Built It" article. This section features circuits and devices contributed by our readers, but which we have not actually tested in our laboratory. We can accept no responsibility for the designs in this section, nor can we advise on possible changes to them. As in this case, we normally publish the author's name and address so that other readers with problems or queries relevant to a design can contact him.

**STEREO AMPLIFIER:** I am a regular reader of your magazine but have never seen a stereo amplifier using valves with a power output of about 8 watts per channel. Could you please publish a suitable circuit. **M. R., Moorabin, Vic.)**

● The Playmaster 118 stereo amplifier, using valves, was published in August, 1967. This delivers 8.5 watts per channel. Copies of the article are available at 20c.

**TELEVISION AERIAL:** Mains-or-car-powered television receivers now abound and many will be out and around during the holiday season in caravans, etc. But there is a problem with aerials. How do you combine compact storage and quick erection with good all-round sensitivity? One wonders about telescopic elements and other variable geometry. What about antenna boosters? **(C. McC., Hawthorn, Vic.).**

● This is likely to be a bigger problem than you anticipate remembering that "variable geometry" has to take in element length, element spacing and vertical and horizontal polarisation. There is also the question of rigidity, remembering that they will often be exposed to coastal winds. Articles on the log-periodic type of all-channel aerial appeared in the December, 1965, and January, 1966, issues and these would be worth looking at if you have any ideas of evolving something for yourself. We do not know of any commercial kit intended for this particular application but it may be worth your while to get in touch with the antenna manufacturers direct to see whether they have anything in mind. Frankly, we would not set too much store on antenna boosters. If the signal available from the usual kind of "Rabbit ear" spikes is too weak for the receiver to use directly, it may also be complicated by ghosting effects. In this case, the requirement is a better signal to start with, not something to make the ghosts more substantial!

**TRANSCEIVERS:** I do not recall that you have ever published a design for a five-band transceiver. I have spent about $300 and about 300 hours working on a transceiver for 80, 40 and 20 metres but it just is not satisfactory. I am ready to buy a commercial unit but cannot afford the expense. Your 21/2 SSB transmitter has a major fault — triple conversion. In a transceiver this would require six mixers. A single mixer with an HF filter should be adequate, as it needs only two mixers, one for the Tx and one for the Rx. I should like to see a circuit for such a unit published by you, using about 12 valves, and perhaps with a transistor VFO which can be switched directly to cover the desired bands. The price shouldd be about $180 and if you had a pair of 6146s in the final these would need an input of 180W. **(J.K., Nedlands, W.A.).**

● We sympathise with you, J.K. It is precisely because of the many hours required in the development of equipment such as you require that we are able to publish such circuits only very occasionally. For this reason, we can hold out little hope for a circuit such as you outline in the near future. You may rest assured that our staff member who designed the 21/2 SSB transmitter considered all aspects before deciding on triple conversion. Major considerations which have to be taken into account are availability of parts, convenienec and simplicity of construction, cost and, of course, performance.

**TRANSISTOR IGNITION:** I am trying to find a circuit for a positive earth 12V transistorised ignition system. Could you let me know if you have such a circuit in any of your back issues, and if so, which it was and whether you can supply me a relevant copy? **(J.P., Georgetown, Tas.).**

● We published a series of articles on transistor ignition in 1964. In January and February, we published introductory articles describing the principles of operation and presenting simple practical circuits. In March, April and June we presented our finished practical designs. A 12V positive-earth system was among the designs in the March issue. Copies of the articles are available for 20c each through the Information Service.

**FRINGE AREA TV.** I am considering building myself a quarter-wave TV aerial to allow me to receive the Sydney channels 7, 9 and 10. I live in Belmont, about 12 miles south of Newcastle. Have you any suitable designs, with details of impedance matching, etc. **(E.M., Belmont, N.S.W.).**

● Your district is outside the intended service area for Sydney stations, and we doubt whether you will be able to achieve entirely satisfactory reception, no matter what aerial you use. We published articles on aerials in April and May, 1962. In September, 1965, we published an article explaining how to stack aerials for fringe area reception. These articles can be obtained through our Information Service for the usual fee of 20c each.

## "ELECTRONICS Australia" Information Service

As a service to readers "ELECTRONICS Australia" is able to offer: (1) Photographs, dye-line prints and other filed material to do with constructional projects and (2) A strictly limited degree of personalised assistance by mail or by reply through the columns of the magazine. Details are set out below:

REPRINTS: For a 20c fee, we will supply circuit data, as available from our files. The amount of data available varies but in no case does it include material additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuit data will be answered more speedily if the circuits are positively identified and the request is not complicated by questions requiring the attention of technical personnel. Where articles are not on file, we can usually provide a photostat copy at 20c PER PAGE.

PHOTOGRAPHS, DYE-LINE PRINTS: Original photographs are available for most of our projects, from 50c plus 8c postage for a 6in x 8in glossy print. In addition, metalwork dye-line prints are available for most projects for 50c each; these show dimensions and the positions of holes and cut-outs but give no details of wiring.

BACK NUMBERS: A fairly good selection is available. On issues up to 6 months old there is a surcharge of 5c. On issues from seven to 12 months old the surcharge is 10c. Over 12 months, it is 20c. Package and postage is 10c extra in all cases.

REPLIES BY POST: This provision is made primarily to assist readers in matters relating directly to articles and projects published in "ELECTRONICS Australia" within the last 12 months. Note, however, that we cannot provide lengthy answers, undertake special research or modifications to basic designs. A 20c query fee must be enclosed with letters to which a postal reply is required; the inclusion of an extra fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries which fall outside the scope of "Replies by Post" may be submitted without fee and may be answered through the columns of the magazine at the discretion of the Editor. Technical queries will not be answered by telephone.

COMMERCIAL EQUIPMENT: "ELECTRONICS Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals receivers, amplifiers, etc. We are therefore not in a position to comment on proposed adaptation of such equipment, or on its general design. "ELECTRONICS Australia" does not deal in electronic components. Prices, specifications or other assistance must be sought from the appropriate advertiser or agent.

REMITTANCES: These must be in a form negotiable in Australia. Where the charge may be in doubt, an open cheque, endorsed with a limitation, is recommended.

ADDRESS: All requests for data and information, as set out above, should be directed to The Assistant Editor, "ELECTRONICS Australia," Box 2728 G.P.O., Sydney, N.S.W., 2001. Other correspondence should be directed to The Editor.

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Sydney: 29-1111; Wollongong: 2-5444.

# ANSWERS TO CORRESPONDENTS—continued

**TESTING SHUTTERS:** Firstly, congratulations on a fine magazine. With reference to your "Answers To Correspondents" in the August issue, several readers request a device to check camera shutter speeds. Some time ago in an American magazine I read an article which explained how to use a home TV set to check fast shutter speeds. The TV line speed is accurate at 15625 in this country which means that, for example in 1/1000 second a photo of the screen would show 15.625 lines. For slower shutter speeds the lines may become difficult to count, but the article suggested mounting the negative in a transparency mount and projecting it. I hope this may provide food for thought. I admit I haven't tried the idea because I have neither a camera nor a TV set. **(J. E., Sherwood, Qld.)**

● Thanks for the kind remarks and suggestion, J.E. Yes, we have heard of this idea before. The main objection to it, as far as the August reader is concerned, is that he sought a system which would give an instant answer, without the need to process a strip of film. There would also appear to be the objection that not all the lines generated in a TV system appear on the screen. In the Australian system there is a loss of some 22 lines per field blanking period, without taking into account any masking at the top and bottom of the tube. Thus it would be perfectly feasible for an exposure to show no pattern at all, or only part of a pattern assuming that the shutter fired at the wrong time. One would have to make a number of exposures and hope that at least one went off at the right moment. Most shutter testers operate on the principle of exposing a photo-cell to a light source, via the shutter, then using the output from the cell to operate some type of readout device, such as a CRO, meter, or digital display. The readout is the hard part, particularly if we wish to preserve the information beyond the moment of exposure. For example, in the case of the CRO, we need a tube with a long persistence screen.

**TREBLE BOOST:** May I compliment you on your excellent magazine, especially in the amount of information you have presented relative to guitar amplifiers and accessories. However, there is one accessory which is sadly missing—an external treble boost unit. Perhaps you could modify your most recent guitar preamplifier unit to make it fill this role. **(G.W., Mansfield, Vic.).**

● It's a bit hard to keep up with what the guitarists want. Not so long ago they wanted bass, bass and more bass. We built extra treble boost into our last guitar amplifier but perhaps you want something to go ahead of amplifiers which lacked this facility. It probably wouldn't be too hard to oblige.

**AMATEUR LICENCE:** Would you please give me any information about the amateur radio licence age limit, and how to obtain a licence. Although I am only 12, I have a growing interest in radio. **(G.S., Hurstville, N.S.W.)**

● You could contact the Radio Branch of the P.M.G.s Department in your State capital for this information, but it would probably be better to get in touch with the Wireless Institute of Australia. Your Divisional Secretary will, we feel sure, give you the necessary information and also tell you about the Youth Radio Scheme in your area. This is an excellent way for intending amateurs to learn the basic principles necessary for the examination and also to meet other youngsters with similar interests. The addresses of the various State Divisional Secretaries are: N.S.W. — 14 Atchison Street, Crows Nest, 2065; Victoria — P.O. Box 26, East Melbourne, 3002; Queensland — Box 638J G.P.O., Brisbane, 4001; South Australia — Box 1234K, G.P.O., Adelaide, 5001; Western Australia — Box N1002, G.P.O., Perth, 6001; Tasmania — Box 851J, G.P.O., Hobart, 7001.

**KNOW YOUR GRAMOPHONE:** What are the chances of obtaining permission from "The Gramophone" to republish in booklet form the excellent series of articles "Know Your Gramophone: A Plain Man's Guide to Records and Reproducers"? **(B.N., Toowoomba, Qld.)**

● For some time we have had the idea of bringing out an audio book but the demands of "Electronics Australia" keep our present staff potential at saturation. We will keep your request in mind but we are not very optimistic of being able to do anything along these lines in the immediate future.

**100 WATT GUITAR AMPLIFIER:** Can you tell me if you have ever described a 100 watt guitar amplifier? I have been reading your magazine for some time now, but have not seen a circuit for a project of this type. **(A.B., Yagoona, N.S.W.)**

● The most powerful guitar amplifier which we have described to date is the 60 watt (RMS) unit published in the July, 1967, issue, A.B., but in the July, 1960, issue we described a 100 watt Public Address amplifier which could possibly be adapted for guitar use. At the moment we don't have any plans for the description of a more powerful guitar amplifier design, so that the latter approach is the only one we can suggest if you really do need an ampilfier of 100 watt RMS rating.

**GUITAR GADGETRY:** I would like to add my support to the representations made by J.H., Gardenvale, Qld., as presented in Answers to Correspondents, in the December, 1968, issue. You are on the right track by producing the articles on the solid state pre-amp, fuzz-box, vibrato, etc. Keep up the good work. **(M.K., Chifley, A.C.T.)**

● Thank you for your letter of support and the comments relating to items to be added to guitar amplifiers. As we pointed out earlier, we can only devote a limited amount of time to such projects, as we have to consider readers whose interests run to other things. However, your suggestions are appreciated and we will keep them on file and we will do our best to present the type of article which you desire from time to time.

**PROBLEM WITH CAPACITORS:** Will you please tell me how to connect condensers to valves. When they are to be connected between valves, which end of the condenser connects to both valves? **(R.C.W., East Orange, N.S.W.)**

● This is the kind of question which we cannot possibly answer in these columns. Your obvious course is to obtain a good basic textbook, such as our "Basic Radio Course," to obtain the background in electronics necessary for practical work. Have you thought about joining the Youth Radio Scheme operated by the Wireless Institute of Australia? Details can be obtained from The Secretary, Youth Radio Scheme, W.I.A., 14 Atchison Street, Crows Nest, N.S.W. 2065.

# ANSWERS TO CORRESPONDENTS—continued

**CRYSTAL CLOCK:** I refer to your December article on crystal clocks. What do you think of the possibility of mixing or beating two crystal controlled oscillators, with a difference frequency of 50Hz and extracting the difference frequency to drive a 50HZ clock movement? With crystals of identical characteristics and in the same environment, it seems possible that a suitable degree of frequency stability could be achieved. I await with interest, future articles on this subject and wish you well in these endeavours. **(G.W.D., Lane Cove, N.S.W.).**

● We have had suggestions from other readers along the same lines. In fact, the author carried out some investigations along the same lines, when overseas some years ago. While the idea seems to be a very good one, the sad fact is that it does not work out in practice. Supposedly identical crystals in an identical environment, just do not behave in exactly the same way. If one crystal should remain precisely on frequency, the other one could conceivably drift off by say, 0.1Hz, which is relatively small. However, if we beat these two frequencies, then we have, say, 49.9Hz and this means a loss of one second in about nine minutes. The same amount of drift, if divided from 100KHz, would amount to a little over one second per day loss. We hope that we have made the point! Thank you for the good wishes.

**PRICES WANTED:** One of your readers complained recently about the lack of addresses in some of the advertisements in "Electronics Australia." May I ask your advertisers, who do not do so, to price their goods. I know most of them do, but are the others afraid to do so? I never enter a shop or do business where goods are not priced. There must be others who feel the same way. **(R.S., Inverell, N.S.W.)**

● We doubt very much that advertisers who do not include prices in their advertisements have any ulterior motives. Usually there is some sound commercial reason, such as complicated price structure, which makes it impractical to give prices. It should be borne in mind that a common price structure for the whole of Australia is not always possible. Any advertiser will quote a price if asked to do so.

**WORD OF APPRECIATION:** I have recently come to Australia from the U.S.A. and have just finished reading the latest issue of your magazine. I feel I must write to you and tell you how much enjoyment, satisfaction and good reading I have just got from it. It is superior to anything I have seen in the States and the price is extra reasonable. I have been in electronics for over 20 years. **(J.H., Kadina, S.A.)**

● We doubt that we deserve such praise but it's nice to hear remarks like this, none the less. We hope that you enjoy being and working in Australia.

**STATION IDENTIFICATION:** For the information of W.A., Berri, S.A., who requested the call sign and address of a station in Vietnam (September, 1968), the station is operated by the American Forces Radio and Television Service. It has its studios in Saigon and operates on 540KHz. Its call sign is AFVN (American Forces Viet Nam). The address is: AFVN Radio, San Francisco, APO 96309, California, U.S.A. **(T.P.W., Sydney, N.S.W.)**

● Many thanks for the information, T.P.W., which we are publishing for the benefit of the original questioner, plus other readers who might be interested.

**RECORD REVIEWS:** I would like to say that I agree wholeheartedly with B.R. of Blakehurst in the November issue of your magazine. I have used the record reviews as a guide to buying over the past year and have not been disappointed yet. **(G.F., Albury, N.S.W.)**

● Thank you for your appreciative letter. We do try to make the reviews as objective as possible, so that readers can judge for themselves whether or not they are likely to enjoy any given recording.

**READER BUILT IT PROJECT:** I am very interested in the small regulated power supply described in the "Reader Built it" columns of the November, 1968, issue. Can you tell me where I can get the components for this project, and how much they would cost? Also how could I add an output voltmeter to the circuit? **(I.McK., Elizabeth West, S.A. 5113.)**

● In general we cannot supply information on "Reader Built It" projects further to that published, I.McK, as we publish all relevant information supplied by the reader concerned. However, a brief glance at the circuit in question suggests that all the parts are quite standard, and should be available from almost any radio parts supplier: We must also refer you to such a supplier for an estimate of the cost of the project. It would appear that you could add a voltmeter simply by connecting a meter and multiplier resistor directly across the output terminals.

**LIGHT AIRCRAFT:** I have read your reply to a correspondent in November headed "Airborne Electronics." Your correspondent has pointed out a field which is not covered in "Electronics Australia," namely that of light aircraft. I am sure that many readers, like myself, must have private licences. Would it be possible to have some details of the circuitry which makes it possible to cover 360 channels in the small space of the new solid-state transceivers? Also on equipment like autopilots, radio compasses, etc? **(B.V., Portland, Vic.)**

● If cost were no problem, we could employ a large team of technical writers, who could be assigned to research and report on various technical fields, developments and pieces of equipment. But cost is very much a problem and we have to rely a good deal on contributed material and on articles for which we can negotiate Australian rights. Articles on equipment for light aircraft seem to be few and far between.

**OLD PARTS:** I read "Electronics Australia" every month but, during the past two years, only one "old radio parts project" was presented to younger readers of the magazine. Most of the projects, using transistors and IC's run into the $40 class **(B.B., Dover Heights, N.S.W.)**

● There was an argument about this some time ago in these columns and we may have been somewhat remiss in this respect. On the other hand, there seems to be less and less interest in valve equipment and more and more pressure to do things with transistors. Still, you have made your point. Thanks for the observation.

**When writing, please make sure your address is complete, including the POSTCODE. Addition of the latter will ensure minimum delay in handling your letter. Also make sure that your address is legibly written or, for preference, PRINTED. A significant number of letters are returned to us each month because the original address was incomplete or illegible.**

## SOUND PROJECTORS

Cinevox Prefect and Hamour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.

**from $90.00**

## CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

**$1.25 each**

Post 10 cents.

## REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule,
1 Lampholder. **$1.85**
Post.: N.S.W. 30c; Interstate: 40c.

## P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

**$23.00**

**(2 TELEPHONE SETS)**

30c cartage to rail. Freight payable at nearest attended railway station.

Please note we are now able to include ½ mile of telephone cable FREE with each set of Phones.

## BATTERY CHARGERS

240 volt A.C. Input.
Each battery Charger will charge either 6 or 12 volt batteries.
2 amp. without meter, **$13.75**
2 amp. with meter, **$15.75**
4 amp. with meter, **$19.50**
Post N S.W. 70c; Interstate 95c.

## MINIATURE ELECTRIC MOTORS

1½ to 3 volts D.C Ideal for model boats, cars, planes, etc. Strong torque. Only **65 cents each or 10 for $4.00.** (Post 7c).

## TRANSCEIVER

(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54 megacycles F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100 K/cs: step 10 channel per meg/cycle with power supply. Leads, mike and headphones **$90.00.** 60c cartage to rail. Freight payable at nearest attended railway station.

## TRANSCEIVER

(2-way radio) 62 set ideal small ships, Hams, etc. 1.6 to 10 megs. Crystal locked or V.F.O. controlled 5 watt output. Complete with antenna, headphones and mike but not air tested. **$60,** air tested **$90.** Not tested incomplete (without accessories **$25**), 60c cartage to rail. Freight payable at nearest attended Railway Station.

## HEAD PHONES

Low impedance moving coil fitted with rubber muffler to reduce external noise, fitted with press to talk, dynamic hand microphones. Ideal for use with all types of transceivers. $3.50 pair. Same with black felt muffler, $4.50 pair.
**Post N.S.W 25c; Interstate 30c.**

## RECORDING TAPE SPECIALS

EMI TAPE at a fraction of the Retail Price, direct from one of Australia's leading Broadcast studios.

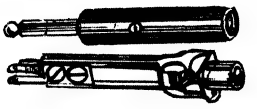
Used in good condition.
**1,800ft, 7in spools, $2.75, post 25c**
**900ft, 5in spools, $1.68, post 25c**
**300ft, 3in spools, 65c post 15c**

## MINIATURE CRYSTAL EARPHONE

With Cord and Plug, 75c. Post 4c.

## 16FT. WHIP AERIALS

**6-Piece, brand new, $5.75. 60c** cartage to rail. Freight payable at nearest attended railway station.



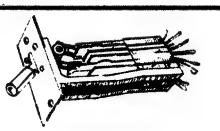
P.M.G. Phone Jack and plugs, 25c each, 45c the pair.
Post 7c.

## NIFE CELLS

1.2 Volt fully charged, 4in x 3in x 1in 4 AH.
**$1.00 each**
Post, N.S.W., 25c; interstate 35c.
1.2 volts 15 AH, 8in x 4in x 2in. **$3.95**
2.4 volt 10 AH, 6in x 2½in x 2in. **$2.50.**
Post, N.S.W., 30c; interstate, 40c.

## WALKIE TALKIE TWO-WAY RADIOS

P.M.G Approved Citizen Band. 9 Transistor. **$79.00 per set of 2.**
Post, N.S.W. 50c; interstate, 60c.



P.M.G. TYPE KEY SWITCHES.
45c each. Post, 15c.

# VALVES

## BRAND NEW

### IN CARTONS

**Special discount for quantity**

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|---|---|---|---|
| 807 | 75c | X61M | $2.20 |
| 65N7GT | 95c | CV850 | $1.50 |
| 8989 | $1.00 | 1H6G | 30c |
| 12SA7 | $1.25 | 832 | $5.00 |
| 5U4G | 95c | 6F13 | 75c |
| 77 | $1.00 | 6AK5 | $1.50 |
| EF50 | 35c | 6X4 | $1.00 |
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| V1103 | $1.00 | 12SK7 | 50c |
| VH120 | 75c | VR1120 | 50c |
| IL4 | $1.00 | VR118 | 75c |
| 5Y3 | $1.75 | VR65 | 25c |
| 6C4 | 50c | VT4C | 75c |
| 2 x 2 | 75c | AU5 | $1.00 |
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| 12AU7 | $1.00 | 6AK5W | $1.50 |

**CATHODE RAY TUBES**

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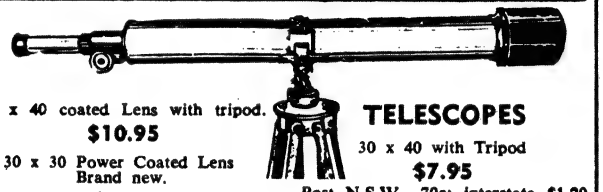
|---|---|---|---|
| 3FP7 | $2.95 | 5BP1 | $3.50 |
| 3JP1 | $2.95 | | |
| V1669 4/1 | $2.95 | CY2184 | $2.95 |

**PLEASE ADD POSTAGE ON ALL ARTICLES**



45 x 40 coated Lens with tripod.
**$10.95**

30 x 30 Power Coated Lens Brand new.
**$3.75**

60 magnification with a 60mm coated objective lens. With tripod.
**$23.00**

As illustrated.
Postage, 95c; Interstate $1.20.

## TELESCOPES

30 x 40 with Tripod
**$7.95**
Post N.S.W., 70c; interstate $1.20

## EX ARMY TELESCOPES

4 x 40 Handley **$6.50**
7 x 40 Otway telescope, **$9.85.**
Freight payable at nearest attended railway station.

## HIGH STABILITY RESISTORS

I.R.C. brand new ½w 1w, 2w, tolerance between 1 and not exceeding 5 per cent including 1K 15K, 22K, 27K, 100K, 180K, 220K, 560K, 820K, ohms. Usual price 40c each, 50 assorted different values for only
**$3.75** Post 15c.

## 522 TRANSCEIVERS

100 to 150 m/cs.
**$35.00**

## TYPE S POWER SUPPLY

(240 Vac supply for AT 5-ARB) suit most types of Disposal transmitters and receivers outputs 250 volt, 10ma 550 volt 200ma, 300 volt 100ma, **$30.00**

## TELEPHONE WIRE

21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile) $7 per coil.
Post, N.S.W. 70c; interstate $1.20.

## SWITCHBOARD FRAMES

Steel ex-P.M.G. Height 45in x 27in x 34in, will make ideal test bench. **$10.**
**$1.00 cartage to Rail.**
Freight payable at nearest attended railway station.

## SCOOP PURCHASE

Gramo Motors. New. Made in U.S.A. 4-speed 240 volt A.C. 50 cyc. Only **$2.75** each.
Post, N.S.W. 30c; interstate, 40c.

## CO-AXIAL SWITCH

70 ohms 4 positions, can be motor driven completely waterproof 70 ohms type connectors. Housed in metal case 9in x 8in x 8in $5.00 each. Post N.S.W 70c. Interstate $1.20.

## C.M.A. CABLE

240 volt 3/.036 black, new and perfect, 100yd rolls **$3.00**; 6 or more.
**$2.50**
30c cartage to rail. Freight payable at nearest attended railway station.

## MICROMETERS

Brand new Slocombe, 1in-2in, $7.85. Post 32c
VIBRATORS, 6 volts, 7-pin **75c** each.
UNISELECTORS, 4 BANK, **$4.00** Post, N.S.W., 25c; interstate, 30c.
INSTRUMENT TRIPODS, sturdy, wooden frame. Telescope. Extend to 4ft 6in .. .. .. **$13.00**
SELSYN MOTORS MAGSLIP Mk. II .. .. .. .. **$5.25 ea.**
No. 19 TWO-WAY RADIOS
Sold a sis without power supply, leads, accessories, etc. Only $15.
Or complete with above gear, $35.

## BINOCULARS

PRISMATIC. Coated Lenses
Brand new. Complete with case.
8 x 30 .. .. .. .. .. .. .. **$18.75**
7 x 50 .. .. .. .. .. .. .. **$22.15**
10 x 50 .. .. .. .. .. .. .. **$23.07**
12 x 5 .. .. .. .. .. .. .. **$23.95**
20 x 50 .. .. .. .. .. .. .. **$26.50**
Post, N.S.W., 70c; Interstate, $1.20

## 3000 TYPE RELAYS

P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

## MINE DETECTORS

Ex A.M.F with Instruction Book. Complete in wooden case. Ideal for plumbers, councils for locating buried pipes, etc. Freight payable at nearest attended railway station. **$39.00**

## 4 DIGIT RELAY COUNTERS

50-volt D.C., suit slot car. Lap counters, etc.
$1.25 each. Post 13c.

## ALTEC STUDIO MICROPHONES

639B Western Electric, top grade, original cost **$250,** ideal Broadcast Studio, music recording, Church and play recording, etc. Fraction of original cost.
Price on Application.

## 240 VOLT 522 POWER SUPPLY

Supplies all necessary voltages to operate 522 transceiver from 240 V A.C. Complete and ready to plug in **$30.00.**

SPECIAL lucky dip valve offer, 15 new valves in cartons for only **$2.00.** We haven't got time to sort them, so you reap the benefit.
Post 60c.

## SOLENOIDS

Plunger Type 12V 300M.A. Suit electric camera control, miniature trains, radio, etc.
**$1.25.** Post, 10c.
200 Mill. amp., 24 volt, 1/8in push movement.
**$1.25.** Post 10c.

## LENSES

TOP GRADE ACHROMATIC 2in DIAMETER, 20in FL ideal as telephoto lens, telescope objectives. **$13.**
Postage 46c.

## CONDENSER LENS

2½in DIAM. 2in FL. **$1.50** each or **$2.50** per pair. Post 21c.

## CONDENSER LENS

1½in diam. 1½FL. **50c** each.
Postage, 17c.

## FOUR CHANNEL BRANCHING AMPLIFIER

With 4in Vu, meter GLORAD. Complete with Portable Power Converter. 600 ohm balanced input and output. Ideal for outside broadcasting, etc.
**$39.50**

## MONITOR SPEAKER UNIT

Ex-A.B.C., consisting of low resistance 8in speaker in Acoustic Labyrinth Baffle Box, complete with 10-watt amplifier, 600 ohms plus 8dbm input, 240 volt A.C. operated.
**$37.50**

## TEN CHANNELS VHF TRANSCEIVER

Types TR1934 100-125 meg/cys. and TR1935 125-150 meg/cycles. 28 volt DC operated AM single crystal locks both TX and RX on same channel complete with generator.
**$33.00**

## CRYSTAL CALIBRATOR

With 500Kc crystal up to 32 meg/cycles.
**$15.00**

## BENDIX BC221 FREQUENCY METERS

Built-in 240 volt power supply, perfect condition.
**$90.00**

## AMPLIFIER

Subminiature 4-Transistor Audio Push-Pull.
**$7.00** Post 50c.

# Deitch Bros.

## 70 OXFORD STREET, SYDNEY, 2010

**SORRY, NO C.O.D.**

# ANSWERS TO CORRESPONDENTS—continued

**OVERLOAD PROTECTION:** Would it be possible to fit overload protection to the "10-Plus-10" Stereo Amplifier of November 1968, using the tungsten lamp method described in the "Audio Topics" columns of December? If so, please let me know where I can obtain suitable lamps. **(N.P., Moreland, Vic.)**

● It would probably be possible to add overload protection in this way, N.P.; the only problem would be to find the appropriate type of lamp. Too low a resistance, and the lamps would offer insufficient protection; too high a resistance, and the power output and distortion would suffer. The thermal characteristics of the lamp are also rather important. We must confess that to date we haven't had the opportunity to follow this up, and accordingly cannot advise as to the availability of a suitable lamp. However, we have been investigating a simple cutout type overload protection circuit using an economy thyristor, and we hope to publish the results in an early issue. Indications are that this method offers complete and foolproof protection, so that it may well suit your purpose.

**VIBRATO TREMOLO:** Would you please advise as to the difference between these two terms as applied to musical instruments? In your November issue a vibrato unit was described, being basically an amplitude modulator. **(P.L., Canberra, A.C.T.)**

● Basically the term "vibrato" refers to a periodic variation in the frequency of a musical note. The term "tremolo" or "tremulant" is a periodic variation in the amplitude. The big problem is that the terms have become confused in their usage with commercial guitar amplifiers and some electronic organs being sold with "vibrato" facilities which are, in reality, variable amplitude. This presents us with the problem that, if we stick to the correct term, potential constructors are put off by the thought that they don't want tremolo, they want vibrato like everybody else! As a rule, we make some reference to the confusion in the article but this may be less apparent than what appears in the heading or in the circuit. Mind you, the distinction is not always as clear as the foregoing. In setting out to modulate amplitude, some systems also have an effect on phase, which is akin to frequency; others, setting out to modulate phase, have some effect on amplitude. But, amplitude, frequency, phase, or combinations of these notwithstanding, it's almost certain that the control on the panel of a commercial instrument will read "Vibrato," so what do we do?

**LASERS:** Could you please advise as to the publications available, technical data and other relative information on laser beam equipment, both theoretical and practical? I have found it very hard to obtain any information on this field and wish to carry out research on laser beam application. Further, could you please supply the name of companies who are manufacturing laser-beam units? Are there any other persons you are aware of in Sydney who are interested in this type of equipment? **(J.W.S., Regents Park, N.S.W.)**

● We are not set up to answer questions of this nature, since it would involve a very complete index of technical publications and subjects, and the staff necessary to service it. The right place to look for such information is the Public Library in Sydney, or in the other capitals. You would find that there is an abundance of literature on lasers, most of it concentrated in the more specialised journals. We imagine that quite a few people in universities and other research centres would be working with lasers. We don't have a list of names, however. You give no hint as to your age group or as to whether your interest in lasers is at a professional or hobby level. If the former, it may be worth your while to get in touch with Varian Pty. Ltd., 38 Oxley St, Crows Nest, N.S.W. 2065, or with Perkin-Elmer, 269 Princes Highway, Dandenong, Vic. 3175.

**CIRCUIT "Q":** How is the "Q" of a resonant circuit worked out in order to work out, in turn, the bandwidth and the place to tap the coil for a required impedance? I have in mind free air coils, slug tuned coils and these wound on ferrite material. Also, could you place in the middle pages projects running over several issues? They could then be lifted out and filed together. **(T.C., Poatina, Tas.)**

● Questions like this cannot be answered in our query service, nor can they necessarily be covered conveniently in general theoretical articles. They involve a broad understanding of components and circuit configuration and are basically textbook material. For example, there is not much point in working out the "Q" of a tuned circuit in isolation; its ultimate characteristics will be affected by what is connected to it, while the position of tappings may be governed by factors other than mere impedance. Regarding the selective placement of particular articles in successive issues, this seems to be a very simple request at first glance. But magazines produced under pressure and to strict copy deadlines are not put together that way. Their makeup is strongly influenced by the order in which work in progress happens to be completed, and this is subject to such very commonplace factors as holidays, sick leave, technical hitches, supply problems and so on. The manipulation of layout to meet "nice if we could" considerations is often too much of a luxury in the face of "getting it out" problems.

**TRANSDUCERS:** I am only 16 years of age but am a keen reader of "Electronics Australia". I have frequently seen mention of "transducers" and "polyplanar loudspeakers". What are they and how are they used? **(M.S., Lithgow, N.S.W.)**

● In the normal context of our articles, a transducer is any device which converts physical movement into electrical signals, or vice versa. A microphone, a gramo. pickup, a strain gauge are transducers which convert physical movement or stress into an electrical signal. A loudspeaker is the best known example of the reverse process, being a transducer which converts an electrical signal into physical movement. By "poly-planar" you probably have in mind loudspeakers which have a flat, moulded cone, suitable for attaching to a plane surface. They are convenient for certain specialised applications but have no special claim to high fidelity. In fact, their performance may be well short of a conventional loudspeaker mounted in a properly designed enclosure. There is also a type of loudspeaker which is intended to activate a thin surface, as of plywood. We have not done any work with these but we don't buy the claims which are sometimes made for them. If ever there is something likely to have strong (and possibly objectionable and unpredictable) acoustic characteristics, it would be a piece of thin plywood! ■

# ALLOY MAGNETS — Continued

this results in a bulkier speaker because the minimum height of the assembly is limited.

When modern product design created the demand for slimmer styling in radio and general loudspeaker enclosures, the use of ferrite magnets gave a distinct advantage. This was because the ferrite magnet allows very short magnetic lengths where large area can be tolerated. So a much flatter design was possible using a ferrite ring magnet set between soft iron plates and around a soft iron centre pole, as illustrated in figure 4.

Loudspeakers take up about 25 per cent of the permanent magnet production today. Ferrite magnets are also finding widespread use in DC electric motors — particularly in small domestic appliances such as electric shavers — and in drive motors for auxiliary equipment in the motor car. The car windscreen wiper motor is probably the most common permanent magnet motor in use today.

The magnets used are formed in an arc that matches the armature radius and are anisotropic, or aligned, for radial magnetisation. The permanent magnet replaces the wound field, resulting in reduced motor diameter and weight, lower temperature rise and lower current consumption.

Permanent magnets also play a vital role in instrumentation. They are widely used in both moving coil and moving magnet instruments. Basically such an arrangement produces a concentrated uniform radial magnetic field in the air gap. The coil is suspended in this air gap and moves in response to current applied.

Another familiar domestic use is the "watt-hour" or electricity meter, and each of these uses four (or sometimes eight) permanent magnets. In an AC watt-hour meter a disc of aluminium, rotated electro-magnetically, drives a counter. The speed of the disc must be proportional to the power, and accurate braking is required. The braking is produced by the generation of eddy currents in the disc as it rotates between the poles of a permanent magnet. The disc and shaft rotate in the assembly on a magnetic bearing consisting of two small magnets in repulsion so the disc literally floats on magnetic flux. The principle of this application is illustrated in figure 5.

Then there are the wide applications throughout the telecommunications industry. Here the familiar application is the ear-piece of the telephone, using what is known as a "rocking armature" receiver. The magnet is used to polarise the yoke and armature which are acted upon by AC current passing through the coils during operation. See figure 6.

A problem of a specialised nature which was overcome with the use of magnets supplied by Plessey Rola division is to be found in the Australis satellite in the Oscar series (Orbiting Satellite Carrying Amateur Radio). To keep the satellite correctly oriented in relationship to the earth, and generally stabilise the satellite motion, a magnetic attitude stabilisation system has been incorporated consisting of a permanent bar magnet and hysteresis rods. This system is designed so that the satellite throughout its flight remains aligned wth the earth's magnetic field.

To further enhance their reputation for being universally applicable, permanent magnets have now moved out on to Australia's great new mineral development frontiers. Here the slurries containing precious nickel ores are run through permanent-magnet, wet-drum separation equipment, to rid the ore of the ferro-magnetic impurities, usually in the form of magnetic pyrite. The same process is used in reverse to remove non-magnetic impurities from iron ore.

It can be said that a new use for the permanent magnet can be found almost every day. There's even news just to hand that horticulturists at the Utah State University in America have suggested that magnetic fields can hasten the development end ripening of tomatoes! ■

# SIMULATION—Continued

"monkey wrenches" are dropped by the A.M.A. into the proceedings at preset intervals — an unexpected surchage on taxes, a faulty computer that makes exasperating mistakes, an untimely resignation of a key man. The participants go through professional purgatory for a week — but take back to ther own companies a reinforced capability for decision-making that they can apply to real companies in a real world.

The most tantalising and most difficult assignment for simulation is reproducing the conditions found in outer space. We need to be prepared for it, yet there are relatively few ways to create artificially the experience of space for the men who need it. But, with today's simulation, scientists can construct an experience no one has been through to date. Three computers run an Apollo Mission Simulator at Clear Lake, Texas, near the Manned Space Flight Centre in Houston, Texas. Astronauts training for descent to the moon sit in a capsule surrounded by a battery of television and motion picture screens and planetarium projection equipment. Added realism is provided by the sound of rocket engines being ignited. Every detail of the entire multi-day mission can be simulated, except weightlessness. In other simulators used by NASA, weightlessness too is duplicated.

For the final stages of descent to the moon, a huge simulator — the marvellous grandchild of a Link Trainer and a computer — is used. It stands 250ft high, 400ft long, and 300ft wide at the Langley Research Centre. The Lunar Module is within it. Cables counteract five-sixths of its weight while the astronaut manoeuvres the crucial 200ft from lowest point in orbit to landing on the moon. If he crashes here — and there are some inexperienced drivers — he can shake it off. There is time and equipment for him to practise on before the real trip into real space has to be made. He has the opportunity to make mistakes without paying dearly for them. ■

# CLASSIFIED ADVERTISING

## FOR SALE

**RECORDING** Tape less than wholesale. 1,200ft $2, 1,800ft $3, 2,400ft $4, 3,600ft $5. Radio Mart, 155 Castlereagh St. (between Market and Park Sts.), Box 4913, G.P.O., Sydney.

**RECONDITIONED** Channel Master "Telstar" transistorised aerial booster amplifiers, $25 ea. Also Channel Master automatic antenna rotators $40 ea. Freight free. J. Yalden, 21 Oxford St., Glen Innes, N.S.W., 2370.

**CHEAP** TRANSISTORS, 2N3055, Also 5% 1W zeners, transistor heatsinks and hardware. Please inquire: E.S. and I., 81 Prospect Rd., Summer Hill, N.S.W. 2130.

**NEW** OC71, 5 for $2 or 50c ea.: OC44, 45, 60c ea.; OC72, 84, AC128, OA210, 75c ea.; OC171, 2N370, 371, AF116N, 117N, OA31, OA211, 90c ea.; Power types 2N176, $1 ea.; 2N301, $1.20 ea.; OC28, 29, 35, 36, $1.50 ea.; FET 2N4360, $1.20 ea.; BC108, 109, 70c ea. BF115, AC127, 2N3638, 90c ea.; OA81, 85, 91, 95, 30c ea.; EM401, BA100, 50c ea.; UJT, 2N2160, $1.20 ea. No S.A. Sales. Pack and post, 15c. Custom Electronics, Box 1452 G.P.O., Adelaide, 5001.

**RESISTORS**, new top grade, all 5 pc tolerance. ¼W, 4c each or $3.00 per 100. ½W, 5c each or $4.00 per 100. 1W 8c each or $6.50 per 100. Quantities may be made up of any value between 1 ohm and 10 meg. We supply to your list. Pack and post, 10c any order. Prompt service. Kitsets Aust., Box 176, P.O. Dee Why, N.S.W. 2099.

**ELECTROLYTIC** CAPACITOR PACK, 10VW, 5 each of the following values: 5uF, 10uF, 25uF, 30uF, 50uF, 100uF, 200uF and 500uF. A total of 40 capacitors. Price $5.70 plus 10c pack and post. All capacitors top grade. Kitsets Aust., Box 176, P.O. Dee Why, N.S.W. 2099.

**RESISTOR** PACKS, New, top grade, all 5 p.c. tol. We will supply three resistors of the 57 different values between 10 ohms and 1 meg —171 resistors. ¼w types $5.10; ½w types $6.84; 1w types $9.90. 10c pack, and post any order. Kitsets Aust., Box 176, P.O. Dee Why, N.S.W. 2099.

**ELECTROLYTICS**, 25VW. Miniature type, top grade. 2000uF, 95c; 1000uF, 60c; 500uF, 40c; 200uF, 29c; 100uF, 25c; 50uF, 21c; 25uF, 20c; 10uF, 18c; 5uF, 16c.
**ELECTROLYTICS**, 10VW. 1000uF, 49c; 500uF, 33c; 200uF, 25c; 100uF, 19c; 50uF, 17c; 30uF, 15c; 25uF, 14c; 10uF, 13c; 5uF, 12c. Pack and post, 10c any order. Kitsets Aust., Box 176, P.O., Dee Why, N.S.W., 2099.

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**CUSTOM - BUILT TRANSFORMERS**: Power, audio, etc. Single or quantity production. Amplifiers, P.A. systems, battery chargers, Rectifiers, electric motors, transistor radios. General engineering, fitting and turning, sheet metal work, etc. Parkinson Transformers, P.O. Box 523, South Brisbane. Phone Beenleigh 33.

**SOUND ADVICE** on stereo equipment, complete outfits, separate units. Stereo Supplies, 97 Minto Crescent, Arana Hills, Brisbane, 4054. Phone 55-3643.

**HALLICRAFTERS** T.O. keyer HA1, $75.00, as new. Sydney. 31-7265.

**TWO-WAY** RADIO VHF 120KHz, 1 base, 3 mobiles, re-licensed remote country areas only. Superceded Adelaide. D. G. Hall, 27 Shaftesbury Terrace, Marino, S.A. 5049.

**COLLINS** S-line 32S-3 transmitter, 75S-3B receiver, 516F-2 power supply. Perfect condition, $1,100 firm. R. Shuetrim, 19 Stirling Cres., Lilli Pilli, N.S.W. 2229. Tel. 524-3893.

**MODEL ENGINEER'S** bench drill. Detail blue print, castings. Bolton, 72 King St., Sydney. Box 1747, G.P.O. Catalogue $1.00.

**TWO** FILM PROJECTORS, 35mm with C and W P6 heads, Westrex rectifiers auto DC arcs, Westrex "20/A8" sound, includes "Paradise" Cinemascope lens, H and B lamp houses, two roll-up plastic screens, $300 or best offer. Theatre, Barellan, N.S.W.

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**GARRARD** rec. changer RC 75A with stereo cart. 3 speed. $10. Hammlund sup. pro. Rx. gen cov., $75. VK3APC project Rx. all transistor. $65. Also 3 Xtal converters, 2/20/40. $35. Pye Goldgrove 4 sp. rec. player. $19. Atkins sig. gen. CT53. 9/300MHz., $40. 2/813 G.G. l.n. amp., $80. O.N.O. VK3XV Oak., Vic. 57-1472.

**FLASH TUBES** and **TRIGGER TRANSFORMERS**, photo or strobe. 4 to 200 joules. All ex stock. Circuit Components (A/asia) Pty. Ltd. 460 Bexley Road, Bexley, N.S.W. 2207. Phone: 59-6550.

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The Manager, FNQ-10,
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**TAPE** to disc service. Take advantage of W. and G. Records' professional experience when next needing a tape to disc service. W. and G. Record Processing Co., 185 A'Beckett Street, Melbourne. Tel.: 329-7255.

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☐ 2. I listen seriously to the melody, rythm and general form of the music, but I am not a hi fi enthusiast. (3,4,6,7,12)

☐ 3. The texture and detail of all instruments and their correct realistic reproduction, is most important for my complete enjoyment of music. (5,8 - 12)

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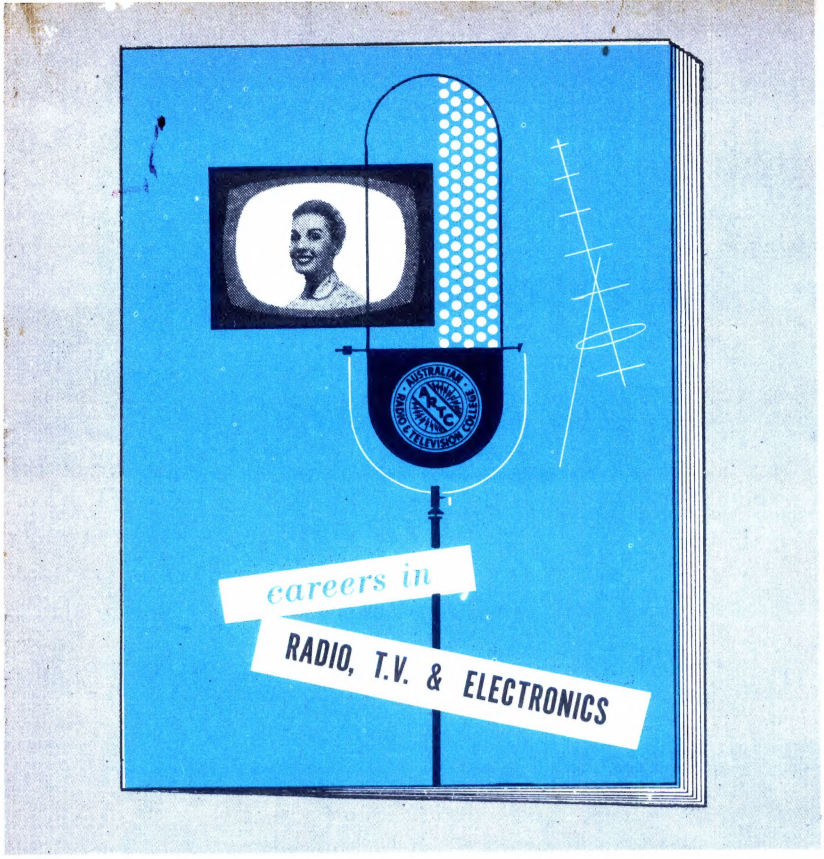


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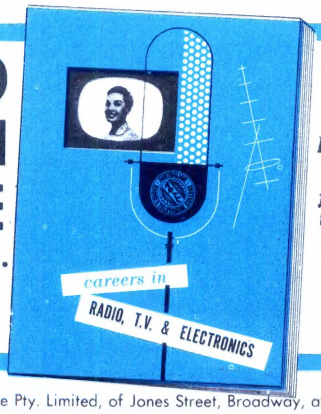


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